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FLIGHT

AIRCRAFT, SPACECRAFT, MISSILES

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The Royal Comet Incident

"WE are satisfied that there was no danger of collision, and we also fully accept that the German pilots did not realize that Her Majesty was in the aircraft, and that there was no intended discourtesy." Therefore, the Secretary of State for Air concluded in the House of Commons on November 9, we could set our minds at rest on the two main issues of anxiety arising from the near-miss between the RAF Comet carrying the Queen and two West German Sabres.

In fact the main "issue of anxiety" remains, exactly as outlined in *Flight* two weeks ago. This is the essential need for an integrated civil/military air traffic control system in this country and in Europe. Although the report of the Committee of Investigation in this particular case has not been published the main facts of the incident—including a conflict of evidence between an estimated 3,000ft and 300ft—have become known. The facts show a number of minor gaps in the smooth flow of air-traffic information. That these errors were possible in the context of a Royal flight is a thought which underlines the dangers inherent in *all* flights over Europe.

Germany's Choice

FIFTEEN years ago the United Kingdom had come to the end of the greatest war in history, and her chief opponent lay in ruins. Last week British newspapers petulantly complained that the same country, now the German Federal Republic, was not buying as many armaments from Britain as she should. Thus are old scores forgotten amid the commercial pressures of the modern world. The whole vast Cold War may before long be an unsavoury memory; but the ideal of a world devoid of armaments is not yet realized, and fighters, tanks, guided weapons and minesweepers are still products that Britain would like to export in greater quantity.

There are few countries outside the Communist bloc whose armed forces do not owe a great deal to British training and equipment, and even in such neutrally disposed nations as India, Peru and Sweden, our military aeroplanes have won many orders—often in the face of intense competition. Sometimes our success has been remarkable—as, for example, when the Germany Navy bought 68 Sea Hawks to equip her first fighter squadrons.

Now this demure maid-of-all-work is to be replaced in the *Kriegsmarine* by the most glamorous fighter of all, the Lockheed F-104G Starfighter. Germany has no carriers, and her naval Starfighters are unlikely to differ much from those of the Luftwaffe. Moreover, she is forbidden by the Brussels Treaty from having other than defensive forces; so her admirals might have found it difficult to make out a case for the Blackburn Buccaneer. To replace its squadron of Fairey Gannets the same service has chosen the Breguet Atlantic—again a logical choice, for, like the Starfighter, the Atlantic is virtually a NATO standard.

Germany has no reason to be partial in placing contracts, but Britain has found herself increasingly isolated in trying to sell to NATO. Two fundamental reasons for this are the emergence of the Common Market and the psychological dominance of the United States. To these we add a third: Britain's own reluctance to join in as a true partner. It is difficult to assess to what extent this unwillingness stems from pride; but it seems largely responsible for the fact that we have no share in any big NATO airframe or missile programme. And if we loftily declare "Here is a VTOL fighter; we are prepared to let you buy some," the situation may persist.

FROM ALL QUARTERS

Polaris in the News

ALL test objectives were accomplished by the first Polaris A-2 to be launched. Fired from one of the "flat pads" at Cape Canaveral on November 10, the 30ft 6in missile flew about 1,600 miles down the Atlantic Missile Range. Design range of the A-2 is 1,500 n.m. (1,727 miles). According to *Missiles and Rockets* "A-2 will have a longer first stage, a slightly shortened second stage, and improved propellants in both stages. Second-stage motor casing will be fabricated of Spiralloy [glass filament spun with epoxy resin]." Much Minuteman knowledge has been carried across to A-2. The first Fleet Ballistic Missile Submarine, USS *George Washington*, took on her first load of 16 A-1 missiles early in the month, and was due to leave on her first operational patrol on November 15. It was said that she would be "somewhere in the Atlantic."

Improved Buccaneers?

ACCORDING to the London *Daily Express*, the weight of the Blackburn Buccaneer has "risen sharply" so that its twin de Havilland Gyron Junior turbojets are no longer powerful enough. In their place would be installed "a military version of the Rolls-Royce RB.163." In fact, although the Buccaneer Mk 1 has a thrust/weight ratio much less than that of most combat aircraft, it fully meets the Royal Navy's specifications, and the 50 on order are unlikely to be altered. On the other hand, an advanced Rolls-Royce engine could certainly result in an improved version. Last week the 11th of the 20 pre-production Buccaneers was in Malta, preparatory to joining *Ark Royal* in the Mediterranean.

Pilots' Peep Show

A NEW visual director system to be known as PEEP—pilot's electronic eye-level presentation system—has been produced for the Ministry of Aviation by Rank Cintel Ltd, a company within the Rank Organization.

Speed, altitude, elevation, directional and other information is presented optically in the form of a pattern of symbols representing the aircraft, the horizon, and a flight-path over the ground. These are viewed through the windscreen, and sufficient essential information is provided to make "head-up" approaches possible. The system has been successfully tried in flight and it is suggested that it forms a link between present landing techniques and fully automatic blind landing.

New Westland Directors

TWO appointments to the board of Westland Aircraft Ltd have been announced. Mr L. Boddington, CBE, MIMechE, FRAeS, at present Director-General of Aircraft Research and Development (RAF) at the Ministry of Aviation, is to become technical director (development); and Mr R. Hafner, FRAeS, at present chief engineer and special director of Westland's Bristol helicopter division, is to be technical director (research).

Mr Boddington has been in his MoA post since last year, having previously been Director, Research and Development (Naval), at the Ministry of Supply since 1953. Among the developments with which he was concerned were the angled and the flexible deck. He received the RAeS Bronze Medal in 1953 for important contributions to naval aviation, was awarded the American Medal of Freedom for his general contribution to the development of aircraft carrier equipment and was appointed CBE in 1956, for major contributions to naval aircraft development.

Mr Hafner, who was born in Vienna in 1905, assumed his present position this year. He joined the Bristol Aeroplane Co in 1944 as chief designer in charge of helicopter development, being responsible for the Sycamore and Belvedere range of designs. He received the Alexander Klemin Award in 1953 for notable achievements in the advancement of rotary-wing aeronautics, the Louis Breguet Memorial Trophy in 1957 for many achievements of great value in the helicopter world, and last year the George Taylor (Australia) Gold Medal from the RAeS.

Mr Raoul Hafner (left) and Mr L. Boddington

"Neither Danger Nor Discourtesy"

FURTHER information on the incident involving two Sabres of the West German Air Force and the RAF Comet carrying the Queen on October 25 was given by the Secretary of State for Air in the House of Commons on November 9. The main conclusions which Mr Amery reported were that neither danger nor discourtesy to the Queen was involved.

The Anglo-German committee of investigation, the Minister said, had visited all the headquarters and operational stations concerned. He continued:—

"The Committee found that the Comet was flying on its way from Copenhagen to London Airport in accordance with current air traffic procedures. The F-86 aircraft were carrying out a battle formation exercise from Oldenburg. They sighted condensation trails at a distance of 10-15 miles and closed on them from approximately an ahead position until they recognized what they subsequently described as a 'transport or bomber type aircraft.' They then pulled away. The Comet co-pilot could not know that the F-86 pilots had sighted him and acted correctly in reporting an air-miss.

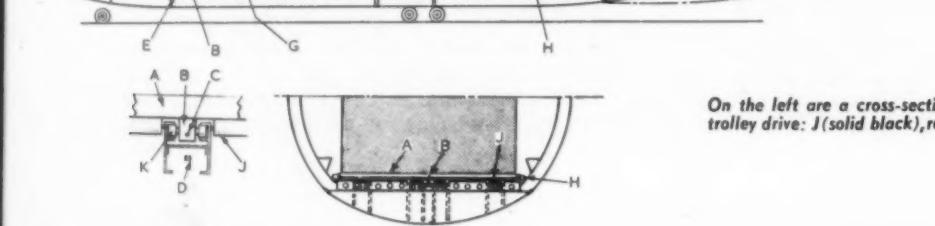
"The Committee has been unable to establish the exact distance by which the F-86 aircraft cleared the Comet, but it is satisfied that since weather conditions were clear, and the fighter pilots had the Comet in view the whole time, there was no danger of a collision.

"Even before the Committee of Investigation was convened the Federal German authorities had conveyed to our Embassy in Bonn expressions of regret that the aircraft carrying Her Majesty the Queen should have been involved in such an incident. This statement has been agreed with the Federal German authorities."

Mr Geoffrey de Freitas asked the Minister whether he would not "use this incident to spur on the negotiations for joint civil and military air traffic control in Europe and a standardized system of air traffic notification." In reply Mr Amery gave further details of the October 25 incident. The German authorities, he said, had been given "all the necessary information" about the outward and return flights of the Queen's Comet; and this had been passed on to all airfields, including Oldenburg. At Oldenburg, pilots had been briefed on the Royal flights on the day of the outward flight but had not been reminded on the day of the return flight—nor were they given any special instructions. "It is possible," Mr Amery commented, "that, if, on that day, special instructions had been given or a reminder issued, the incident would not have taken place."

The possibility of issuing separate notices in future was being considered. No formal request for special restrictions had been made to the Federal German Air Force, although an RAF officer had unofficially suggested to "the German side" that they might consider taking precautions similar to those in effect in British air-space. "I agree that one of the lessons we should draw is that we should take up with our European neighbours some agreed procedure corresponding with what we call 'purple airways' in this country. . . ."

An irregularity in procedure, albeit one which Mr Amery



BRITANNIC CARGO will be loaded by a Short-developed system of pre-filled bins (shaded) locked together and run along a roller/ball conveyor system from the terminal by a powered trolley in the aircraft: A, pallet; B, trolley; C, cable; D, chain; E, hydraulic motor and reduction gearbox; F, pallet stop; G, pallets interlocked; and H, pallet restraint pin

On the left are a cross-section of the floor and a detail showing the trolley drive: J (solid black), roller conveyors for pallets; K, trolley rollers

***SUPER STARFIGHTER** is the name of the Lockheed F-104G, the first of which (for Germany) is now being tested at Palmdale. More than 1,300 are to be built outside the USA, at a cost of $2,225,000,000*

described as having no bearing on the incident at all, was disclosed by Mr John Hall in a later question. An amendment to the original Notam, the Minister said, concerning a change in height from 36,000ft to 35,000ft, had not been passed on to the German Air Force.

Behind Mr Amery's statements lies the fact that practice interceptions may be made by West German Air Force fighters on other combat aircraft in clear conditions. Normally the intercepting pilot is required to break off at not less than 1,000ft although, if the target aircraft is recognized as a civil or military passenger type, pilots are expected to break off immediately. It is believed that the two Sabre pilots claimed that they had approached no nearer than 3,000ft to the Comet and that they first recognized the aircraft as a "transport or bomber type" at about five miles. The Comet co-pilot's estimate was that the Sabres had missed the Comet by 50ft vertically and 300ft horizontally. The complete report of the investigating committee is not to be published because, according to an Air Ministry spokesman, it is not the Ministry's policy to publish results of boards of inquiry.

Royal Prizegiving

"THE transition from student to fully-fledged professional is by far the most profound change of status that anyone has ever to go through: you are on your own at last. On behalf of all of us here, who are already floundering on our own more or less successfully in the complicated patterns of existence, I wish you the very best of luck."

The Duke of Edinburgh addressed these words to students of the College of Aeronautical and Automobile Engineering at their annual prizegiving on November 8. Speaking as the retiring president, he went on to say: "you will be interested, I think—and all of you will be delighted to know—that Sir Matthew Slattery, the chairman of BOAC, has agreed to be the next president of this college." At the conclusion of his address His Royal Highness unveiled a memorial to the founder of the college, S. C. Roberts.

Mr John Williams, the principal, said that they had continued their policy of acquiring new equipment both for experimental work and for practical training. This had enabled them to extend the training potential, and during the year there had been a first course in basic electronics for mechanical engineers.

Awards in aeronautical engineering were as follows:—

Mollison Challenge Trophy, R. D. Thompson. **Olley Challenge Trophy,** M. Kreisberger. **Nelson Memorial Prize,** P. J. Hawtin. **Principal's Prizes,** G. R. Atiyyah and R. K. Satjadibrata.

Edwardian Precepts

BRITAIN'S decision to purchase Skybolt was commended by Sir George Edwards as "eminently sensible" when he spoke at the Mansion House luncheon held by the Air League of the British Empire on November 8. In his speech, Sir George—executive director, aircraft, of the British Aircraft Corporation and managing director of Vickers-Armstrongs (Aircraft) Ltd—discoursed on defence policy since the "famous White Paper" of 1957 and the aviation scene since the Ministry of Aviation was formed. His main point on defence was that with a limited budget we should make the best use of our resources. He spoke of the respect in which RAF Bomber Command was held by the USAF Strategic Air Command: our own Blue Steel, he said, gave a further degree of penetration and immunity to the carrying aircraft; Skybolt fitted to the V-bombers should extend their credibility as a weapon system until at least the early seventies.

On the industry, Sir George begged that projects should not be started and stopped at Ministerial pleasure. One big aircraft company had not completed a single major contract since the war without the break clause being invoked.

The League's President, the Duke of Hamilton and Brandon, in thanking Sir George referred to him as a "great designer, engineer and ambassador for the British aircraft industry."

Aviation's "Articulateness"

CHANGES in aeronautical journalism, from the days when "flying itself was still rather wonderful" to the advent of "missile jargon," were reviewed with percipience and humour by Maj Oliver Stewart when he gave the seventh Sir George Cayley Memorial Lecture—on *Forty Years of Aviation Writing*—before the Brough branch of the Royal Aeronautical Society in Hull last week.

Maj Stewart reminded his audience that Cayley himself was "one of the best aviation writers," his notebooks abounding in telling phrases: his greatness was the outcome not only of his ideas, but of his power to express them. It was largely because it was articulate that aviation had made progress; and the instruments of its articulateness had been papers presented to learned societies, articles in the specialist and lay Press, and broadcasting and television.

From his own rich experience of aviation, both as a pilot and as an aeronautical journalist, Maj Stewart reviewed the changes which have taken place in the last forty years and made some detailed comments on style and phraseology. He suggested that the "period of routine air reporting" ended with the Second World War. The 1920s and 1930s, when so many record flights were made, were the days when aviation *was* news. When flying began to lose its novelty, "aeronautical writers spent less time on aerodromes and more time in conference rooms listening to the platitudes of ministers and trying to squeeze news stories out of them."

Maj Stewart made a plea for verbal redundancy, which could "form a fail-safe writing," providing overtones which lend distinction to an opinion; and he averred that British aviation is "well served by its specialist Press."

Hawkeye Flies

DURING the last week of October Grumman flew the first W2F-1 Hawkeye from their test airfield at Peconic River, NY. Winner of last year's competition for the future carrier-based early-warning aircraft of the US Navy, the Hawkeye is an enlarged derivative of the WF-2 Tracer, aimed at achieving much greater speed, altitude and endurance. Major features include two 4,050 e.h.p. Allison T56-A-8 turboprops, accommodation for a crew of five in a pressurized fuselage, and a span increased to 80ft.

IN BRIEF

As we go to press the Admiralty announce that the US Navy's Sidewinder IR-homing air-to-air missile is being purchased for issue to Scimitar squadrons. No further contracts for Aden ammunition are being placed. The Scimitar is a day fighter/bomber with a radar-ranging gun-sight; it cannot readily accommodate the Firestreak weapon system.

Discoverer 17 was successfully launched into orbit by the US Air Force from Vandenberg Air Force Base on November 12. The launching vehicle was a Thor-Agena B, and the initial period of the near-polar orbit was reported to be 96.45min. The 300lb capsule was caught in mid-air—the second successful aerial recovery of a satellite—as it descended by parachute on November 14 after its 31st orbit. The launch and recovery were described by the USAF as "our most successful operation in the Discoverer series."

Hawker Siddeley Group's Middle East office is to be established in the British Bank Building, Beirut. It will be under the control of Mr J. K. Brown, previously of D.H. Engines and the D.H. Enterprise.

We announce with regret the death of Mr N. A. Champion, works director of Rotax Ltd, who died last Saturday, November 12. Chief inspector of the company before his appointment to the board, he had been connected with production for many years and had completed 25 years' service with Rotax. He was due to retire next month.

A new Cessna light twin, according to *Aviation Daily*, will incorporate a unique "push-pull" engine arrangement. One Lycoming 180 h.p. engine is in the nose, as in the Cessna 210, with the second located aft of the cabin between twin booms and powering a pusher propeller. It is reported that the new aircraft will cost $20,000-$25,000 and will go into production in 1962.

The first supersonic aircraft to be produced at the Hindustan Aircraft factory in Bangalore, south India, will be completed early next year; a fighter, believed to be powered by two advanced Bristol Siddeley Orpheus with reheat, it has been designed by a team under Dr V. M. Ghatage. The first Avro 748 being built in India, at Kanpur, is due to be ready at about the same time.

Breguet Garrett SA has been formed in France to manufacture selected products designed by the Garrett Corporation, Los Angeles. The new company is owned equally by Maison Breguet, Westland Aircraft (as parent company of Normalair) and Garrett International SA, Geneva. It will manufacture air-conditioning systems designed by Garrett with applications for new jet aircraft being developed in France.

Missiles and Spaceflight

Left, pre-launch picture of Mercury capsule on top of Little Joe booster at Wallops Island on November 8. Above, another unsuccessful launch on that date was of a Blue Scout from Cape Canaveral: this artist's impression shows the intended separation of second and third stages

SPACE DECISION THIS YEAR

Although the responsibility for this country's space research efforts lies with the Minister for Science, Lord Hailsham, the financial and political implications of the possible use of Blue Streak and Black Knight as the basis of a launching vehicle have led to the Minister of Aviation's acting as the main Government spokesman on the subject in recent months. On November 7 Mr Thorneycroft spoke in the House of Commons on the topic of space co-operation with other countries in Europe and the Commonwealth.

"If a heavy rocket for satellite launching is to be developed outside the United States or Russia," he said, "there are substantial advantages for all concerned in doing it in co-operation with our friends in the Commonwealth and Europe. The Government have been and are exploring the possibility, but I would like to carry our consultations rather further before making any statement."

In further replies to supplementary questions Mr Thorneycroft said: "I have had talks in Australia and Canada, and I have recently been in consultation with representatives of the French Government . . . the suggestion I made to the French was that we should have full collaboration with them both in finance and technology. It was to be based on the work which we have done on the Blue Streak and Black Knight projects. . . . I certainly think we ought to make up our minds before the end of the year what the answer should be. I hope the House will give me a little time to finish the talks on which I am engaged at present."

BLUE SCOUT FAILURE

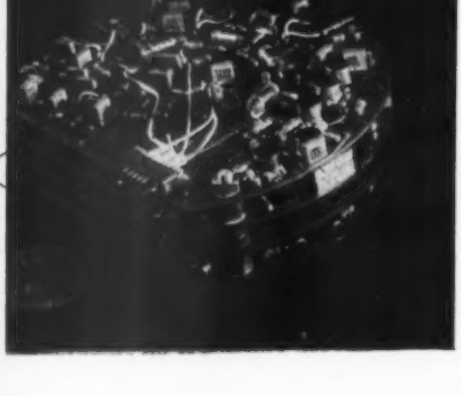
Directed and supervised by the USAF Ballistic Missile Division, the Test System 609A Blue Scout programme suffered a second setback on November 8 with an unsuccessful launch from Cape Canaveral. The second stage was reported to have burned-out prematurely and the vehicle fell into the Atlantic. The payload weighed 29.3lb, slightly less than that of the first Blue Scout launched on September 21, and was scheduled to reach a height of 24,500 miles in 5hr 5min. The capsule contained instruments to measure X-rays, gamma-rays and charged particles above the Earth's radiation belts. In the September 21 launch radio signals from the rocket failed shortly after the vehicle had left the pad, but it was believed that all four stages had functioned properly.

TS 609A is described by the US Air Force as a hyper-environment test system (HETS) used in support of experiments in the upper atmosphere and circum-terrestrial space conducted by Air Research and Development Command. The system is designed for use as a family of special research support vehicles derived from NASA's Scout vehicle. Furthermore, the Ballistic Missile Division states, "TS 609A will provide the Air Force with an economical, reliable and versatile solid-fuel ballistic research vehicle system for testing equipment and techniques and collecting scientific data at space-equivalent altitudes in support of ARDC's mission of advancing the state-of-the-art components, subsystems and specialized methods related to future ballistic missile and military space systems."

The basic components of the NASA Scout are modified in Blue Scout to meet specific Air Force requirements. Modifications effected or planned include attitude stabilization of the final stage and provision for a guidance system in the final stage of the four-stage vehicle. Three-stage versions, and the attachment of wings to certain payloads, are also envisaged.

Among the missions assigned to Blue Scout are tests of vertical and angular launch techniques, ballistic boost-glide and boost-dive trajectories and recovery techniques. The vehicle will be used to carry out experiments for various ARDC centres, and will reinforce the USAF "piggy-back" programme in which scientific research experiments are carried on a space-available basis on all regularly scheduled ballistic missile flights.

Prime associate contractor is the Aeronutronics Division of Ford Motor Co, which is responsible for systems engineering, conduct of flight tests, and manufacture of stabilized recoverable payload carriers.



Developed by Bristol Aircraft for the space research group at University College, London, this electronics package forms part of the X-ray spectrometer which will be included in the payload of the first joint US-UK satellite. It comprises four 5½in diameter modules and in this form — before being potted in polysulphide rubber and foaming resin — weighs about 11oz

MERCURY SETBACK

A test of the escape system of the Project Mercury capsule was unsuccessful on November 8, when the capsule failed to separate from its Little Joe booster after a launch from the National Aeronautics and Space Administration's Wallops Station at Wallops Island, Virginia. The stated test objective was to demonstrate the performance and structural integrity of the spacecraft and its escape system at the highest air loads that can be anticipated during an Atlas-boosted launch for orbital flight.

The escape rocket was fired at 35,000ft as planned, but the capsule failed to separate from the booster and the combination continued to climb to an altitude of 53,000ft before falling into the sea some 13 miles from the launch point.

ADVISORY COUNCIL NOT IMPRESSED

In the *Annual Report of the Advisory Council on Scientific Policy 1959-1960* published last month, the Council reaffirmed its views against an all-British space research programme in the following terms:—

"Since our last report there has been considerable public interest in this subject, arising from the Government's decision to abandon Blue Streak as a military weapon and to consider its use as a vehicle for space research. We have accordingly reconsidered the subject, and reaffirm our previous advice, namely that a programme of scientific research in space using satellites on a purely national basis would not, in itself, justify the very large expenditure necessary for a full-scale programme including the development of a launching vehicle."

This statement has aroused less antagonism from space enthu-

As we go to press this is the only photograph available of the Soviet surface-to-air missile revealed in the parade through Red Square, Moscow, on November 7. It appears to bear the same relationship to the anti-aircraft weapon seen in the same parade three years ago as the US Navy's Tartar does to the original Terrier. The wings have a revised profile and small trailing-edge control surfaces, but the main controls have been moved from behind the wings to a position near the nose. No tandem boost motors were fitted to the new missile

siasts than did the Council's previous report, which said the same thing at greater length, because it now appears to be generally accepted that the question of a major space programme depends on wider issues than scientific research alone. With emphasis on the phrases "on a purely national basis" and "in itself," the Council's opinion quoted above is a sound one.

As indicated in another news item in this section, the answer to the question of a major British programme will be decided not by the possible scientific advantages, but by the chances of international co-operation, the commercial applications of satellites and, above all, by the desirability or otherwise of maintaining a rocket technology in this country.

APOLLO FIRMS NAMED

Contracts for feasibility studies of an advanced manned spacecraft as part of Project Apollo have been awarded by the US National Aeronautics and Space Administration to Convair-Astronautics, General Electric (Missile and Space Vehicle Dept) and the Martin Co. The three six-month contracts are for $250,000 each.

Project Apollo's "proposed multimission capability," to use NASA's phrase, will include a variety of scientific, technological and civilian services as an Earth orbiting vehicle; the project will serve as an intermediate step toward manned space stations; and will make possible manned flights to the vicinity of the Moon.

The first Honest John artillery rocket to be fired in the United Kingdom was successfully launched during a demonstration at the School of Artillery, Larkhill, Wilts, on November 9. Preceded by 16 firings by a Royal Artillery regiment in Germany, this test was over a range of 8,000yd; an inert warhead was used, a magnesium flare being detonated 500ft above the target point to simulate the nuclear blast. An officer stated that accuracy was "within 25yd."

In a written answer in the House of Commons on November 9, the Minister of Defence stated that the RAF, Army and Royal Navy will continue to develop their own surface-to-air missile systems. He said, "The possibilities of standardization have been kept well in mind. There was never any question of adopting Seaslug for land-based use, but the possibility of a single land-based weapon for the Army and RAF was explored. It became clear, however, that no solution on these lines would save money and at the same time provide a satisfactory solution to the needs of the two Services."

A lecture on the British space programme will be given before the Graduates' and Students' Section of the Royal Aeronautical Society at 4 Hamilton Place, London W1, at 7.30 p.m. on November 23 by Mr M. O. Robins of the Ministry of Aviation. Mr Robins is British project manager of the joint Anglo-American satellite programme.

A number of display exhibits on spaceflight subjects are now being made available to schools and institutions by the British Interplanetary Society in co-operation with the United States Information Service. Details are obtainable from the Society at 12 Bessborough Gardens, London SW1.

ROCKETDYNE ROUND-UP

ROCKETDYNE, a division of North American Aviation, have made far more large liquid-propellant rocket engines than all other firms together. Their president, S. K. Hoffman, was recently in England to read Sir Henry Royce Memorial Lecture before the Derby Branch of the Royal Aeronautical Society on November 7. The following is Part 1 of a condensed rendering of his text.

Development and production of large liquid-propellant rocket engines in America was fostered by the Navaho. This weapon, initiated by the Air Force in 1947 and contracted to North American Aviation as system manager, called for the development of a long-range supersonic ramjet cruise missile boosted to operating conditions by a liquid-propellant rocket engine considerably larger than any previously developed. This effort was conducted by a group which has become the present Rocketdyne division.

While utilizing the same propellants, this engine incorporated many improvements and advances over the first large operational rocket engine, for the German V-2. The original engine proposed was to produce 75,000lb thrust. It was to operate at a chamber pressure of 300lb/sq in, and required a turbine system capable of producing 835 h.p. These requirements were met with an engine constructed, in some respects, along classical lines. It used liquid oxygen and an alcohol/water mixture. The double-wall thrust chamber and a steam generator which decomposed hydrogen peroxide to power the turbopump were early V-2 concepts. But the major components and control system were entirely new. Where former systems were complicated interlocks of controls, the NAA engine was simplified. A new thrust chamber provided improved cooling characteristics for the increased heat-transfer rate; an improved single injector design replaced the 18 separate injectors; and a new turbopump with uprated performance was used.

As a result of these changes, a significant improvement in operational dependability was effected. Early testing at White Sands, New Mexico, showed the life expectancy of a V-2 engine to be 10 to 15 short-duration firings. An early Navaho engine was subjected to 115 test firings at White Sands Proving Ground and at the Rocketdyne Propulsion Field Laboratory.

Navaho II, of greater size, called for a cluster of two 120,000lb engines. This led to the development of the first completely modern lightweight engine. Its design initiated several basic trends, towards increased performance, greater simplicity, and reduced weight. A more efficient turbopump was incorporated. To achieve the high flowrates and pressure heads required, propellant pumps operating at 5,500 r.p.m. were developed. These had a suction specific speed of 18,000, a value previously unheard of for this type of centrifugal design, and a geared turbine was used to permit higher turbine r.p.m. This engine incorporated the first "bootstrap" system which eliminated the third propellant normally required for gas-generator operation; instead, the main propellants are bled back from the turbopump discharge lines. This engine also marked the first use of tubular-wall regeneratively cooled thrust chambers, affording a major reduction in weight, fabrication time, and cost.

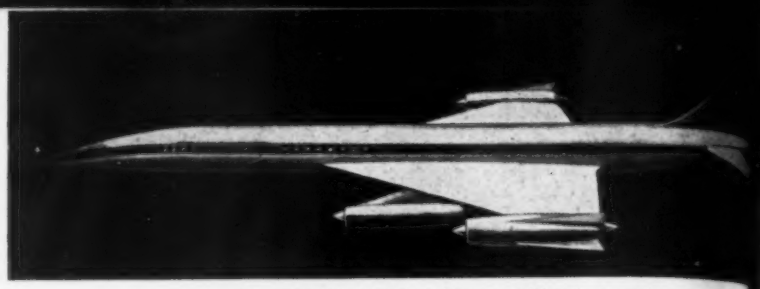
Navaho III, a still larger vehicle, required a cluster of three 135,000lb engines, resulting in a booster stage with 405,000lb thrust. The Navaho III engine was essentially an uprated version of the Navaho II design. Chamber pressure was increased to 500lb/sq in and the turbine was uprated to 2,400 h.p. A significant increase in specific impulse was achieved by using kerosine instead of the alcohol/water mix. The combustion temperature contained within the regeneratively cooled walls was now up to approximately 6,000°F. The three-engine cluster used hinged chambers for vehicle thrust vector and roll control, instead of the less efficient jet vane system. This requirement necessitated the development of large, flexible, high-pressure propellant lines and chamber actuators.

Although the Navaho project terminated before reaching operational status, it left a rich technical legacy in the development of large liquid-propellant engines and in such other fields as aerodynamics, thermodynamics, aeroelasticity, high-speed flight, inertial guidance, material processing, and chemical milling.

Redstone Final development of the 75,000lb engine which had established itself as a dependable powerplant was threatened by suspension early in 1951 when tactical requirements of the

(*concluded on page* 778)

AIR COMMERCE



Convair 58-9: Mach 2.4, 52 seats, 2,500 mile stage-length

AMERICA'S SUPERSONIC PLANS

"By virtue of a lot of concentrated work on this problem the British just about know how to do the [Mach 2.2 airliner] *and, I think, have every intention of doing it. The Americans could undoubtedly find out how to do it."*—Sir George Edwards.

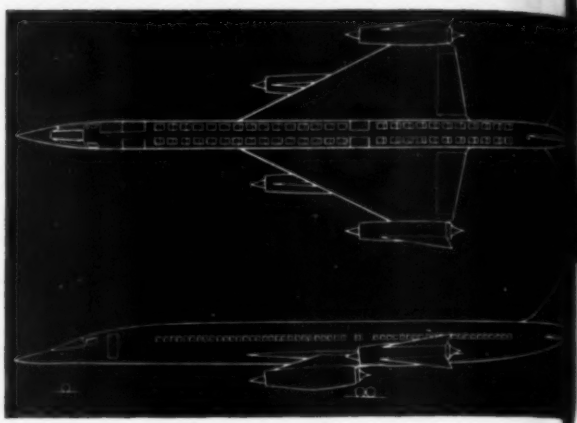
MORE information is now available about the proposed supersonic adaptation of the Convair B-58 Hustler bomber referred to last week (page 761, "Convair's Mach 2 Prestige-Liner"). Convair are evidently in earnest with this proposal, which calls for the following three-stage programme, on a US national basis, to ensure that America is first with the supersonic airliner:—

(1) Simulated airline operational testing of a B-58 bomber. Part of this programme is already scheduled for next year by NASA from Edwards Air Force Base.

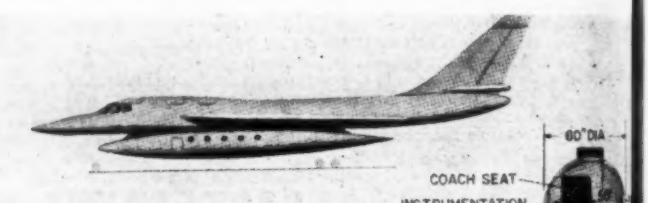
(2) The fitting of a "people pod" to the underside of a B-58A to explore human reaction to supersonic transport.

(3) The building of 12 transport versions of the B-58, designated Convair 58-9, the first to fly in October 1963.

The Convair 58-9, of which illustrations appear on this page, would be a Mach 2.4, 2,500 n.m. medium-haul airliner powered by four P & W J58s of 33,000lb dry thrust each. It would carry 52 passengers two-abreast in a conventional fuselage in place of the bomber body and with a horizontal tailplane. General configuration would not appear to be particularly unorthodox.



Above, general arrangement of the 58-9. Below, the "people pod" for exploring passenger reactions to sustained supersonic flight



The Convair 58-9 is based on work already done by Convair on the B-58C, a proposed development of the bomber based on four J58s. According to *Aviation Week*, in which details are published, "nobody believes that the Convair 58-9 is the optimum supersonic transport, but some do believe that it is the best supersonic transport that could become available in a short-time span . . . Convair is basing its programme on the hope that progressive development through the supersonic range, with more complete understanding of the problems all the way along, will be of greater advantage than plunging directly into the Mach 3 speed range." According to the US magazine, "by Convair's own admission and general agreement among competitors [Mach 2.4] is the wrong speed for a supersonic airliner."

Range of the 58-9 would be 2,525 n.m. (2,900 st.m.) with reserves. At a take-off weight of 190,000lb field length required would be 6,500ft, with a lift-off speed of 199kt (229 m.p.h.). Balanced landing field length would be 8,700ft at a touchdown speed at 110,420lb of 148kt (170 m.p.h.).

The Convair programme assumes that the order to go ahead will be given in January 1961. The first four aircraft would be flight-tested by Convair in an 18-month programme, starting in October 1963, and the remaining eight aircraft would be evaluated over a period of 15 months by the Federal Aviation Agency, the National Aeronautics and Space Administration, and the Department of Defense. Simulated commercial operations would begin early in 1965, with a MATS squadron "doing the operational shakedown." By October 1965 it is planned that the twelve aircraft in the programme would have flown 2,500hr.

So far as cost is concerned the proposal is as follows (sterling equivalents): 1961, £8.4m; 1962, £21m; 1963, £24m; 1964, £16m; 1965, £1.33m.

What of co-operation? No mention is made in the *Aviation Week* article of possible co-operation with Britain or France but, the magazine says, "observers doubt that any combine of US companies would co-operate on a joint commercial airliner."

The proposed programme does not appear to change "the agreed goal of the majority of American entrants now in the running"—namely a Mach 3 airliner.

Another quote from Sir George Edwards:—

"Neither of us knows how to do the [Mach 3 airliner]*—and don't be misled by anyone who says he does."*

THE INDEPENDENTS DINE

"WE stand or fall by the independent judgement of an independent Air Transport Licensing Board. It must be free of Government control." This was said by Mr C. J. Stevens, 1959-60 president of the British Independent Air Transport Association, at BIATA's annual dinner in London on November 9. As usual on this occasion, every section of British air transport was represented. Mr Stevens emphasized especially—no doubt with foreign charter competition in mind—the need for the speedy issue of licences. In the presence of the Minister of Aviation, Mr Peter Thorneycroft, he said that the decision to increase landing fees had come as a "severe blow." Could not fees be related to peaks? In his speech Mr Thorneycroft said that air transport, like any other form of transport, "had to carry its own terminal charges," and airports weren't going to be run as a "branch of the Welfare State." He thought that there should be some measure of independent v. corporation competition, properly regulated by the new Board—which *would* be independent—but "it would be an embarrassment if I had to explain to the Government the disappearance of the corporations." With regard to the speedy issue of licences, he said, he was sure that "we will find a way for you to compete on the Baltic." Recalling how, when he was with the Board of Trade, he had experience of the Restrictive Trade Practices Act, he remarked good-humouredly on how he now found himself in an industry "riddled with international agreements and price rings."

Mr Clive Hunting, of British United, is elected the 1960-61 president of BIATA, with Mr Harold Bamberg of Cunard Eagle as vice-president.

Here, once again, is the same Boeing 707 that has been appearing on these pages for more than six years, the -80. It is now testing new high-lift devices, notably a cuffed wing root, and full span foreflaps

AIR COMMERCE . . .

PETER PAYS PAUL

AS reported by Rolls-Royce to the ATA engineering and maintenance conference in Kansas City last month (see col 2) there have been 34 premature Conway removals between the time the engine went into service in April 1960 and August 31. BOAC services have not been affected but the corporation has recently run very low on Conway spares. Last month a 707 at London Airport was cannibalized and has been left without engines for more than three weeks so that spare engines could be provided for other aircraft in the fleet. BOAC say that their Conway spares holding is small but that there has previously been sufficient engines to cover installation requirements with a minimum of spare engines at home and overseas. Troubles experienced in the corporation's 707s have been concerned with high-pressure compressor blades and these have necessitated engine changes; 20 engines removed prematurely have been returned to Rolls-Royce. Conways removed prematurely have not required overhaul, Rolls-Royce told the ATA at Kansas City; all were returned to service. The supply difficulty stems partly from a fire at the Mountsorrel works last summer, but supplies to BOAC are now some months behind the contract date. The difficulties are being overcome and BOAC recognize Rolls-Royce's strenuous efforts to rectify the position in time for the corporation's summer season, which begins next May.

Conway engines are in service in Boeing 707s operated by BOAC (13), Air-India (3), Lufthansa (4) and Varig (2).

ANSETT'S OVERSEAS AMBITIONS

ANSETT seems determined to defeat the Australian Government's ban on the entry of private enterprise into the operation of Australian air services abroad. Mr Ansett's first move is to secure a "substantial," but minority, holding in South Pacific Airlines (NZ)—not to be confused with South Pacific Airlines of California, which operates into Tahiti. The New Zealand firm has been started by pilots of NZNAC, but will not fly in direct competition with that corporation. SPAL had planned to charter DC-3s with panoramic windows from Hawaiian Airlines, but it will now operate DC-3s from Airlines of NSW, an Ansett subsidiary once known as Butler Air Transport. SPAL will operate at fares below those of NZNAC.

Ansett Transport Industries, the holding company for Ansett Airways, Pioneer Tours, and the various tourist and hotel interests of the Ansett group, has been wanting to get into NZ tourism for ten years at least. It has had several looks at the NZ airline industry and when the post-war Labour Government lost power actually investigated the prospects of taking over NZNAC. Mr Ansett believes there is room on the Tasman for his organization. He wants to buy into New Zealand to gain a foothold in the tourist industry and perhaps then to run charters both ways, carrying tourists for his tours in Australia (existing) and New Zealand (future).

Mr Ansett believes there is one other route which could stand the entry of an Australian private operator—Sydney/Hong Kong. The Ansett Transport Industries holding in Cathay Pacific, the Hong Kong Electra operator, is about 20 per cent. He has hopes of securing a 51 per cent or more holding. Mr Ansett also has in mind a long-standing ambition to be on the Kangaroo route to the UK. How this might be achieved is a fascinating question, but no doubt the British independents are thinking on the same lines—notwithstanding the BOAC/Qantas/Air India pact to keep their tripartite pool tripartite.

ANOTHER LATIN-AMERICAN ACCIDENT

A FAIRCHILD F-27 Friendship of AREA, Aerovias Ecuatorianas, crashed into a mountain about 15 miles from Quito in bad weather on a flight from Guayaquil to Quito on November 7. All 37 occupants were killed and the aircraft was destroyed.

This tragedy was the thirty-eighth fatal accident to a civil transport aircraft in 1960, causing the loss of approximately 979 lives. Of these more than 820 have been passengers and more than 135 crew. (Some accident reports do not distinguish between passenger and crew fatalities.) Of the 38 accidents 16 have occurred in Latin America.

NOT AS BAD AS THEY SEEM

THE recital of the industry's turbine-aircraft snags at the Air Transport Association's Engineering and Maintenance conference in Kansas City last month must read alarmingly to those conditioned only by the selected effluvia of public relations and advertizing departments. But as any good development engineer would say, in this imperfect world there is something wrong with everything, and only by constant striving can mechanical things be put right enough to be acceptable to most of those who design and have to maintain them. By which time someone has generally thought of a different and better way of doing the job anyway.

So the conference—and the health of America's jets and turboprops—should not be judged by revelations that the Convair 880's fuel consumption is 1,000lb/hr greater than anticipated, that five

Pictured with Irish International Airlines' Boeing 720 "Padraig" are a group of captains who were present at the acceptance ceremony in Renton, Washington. Services start across the Atlantic on December 14

AIR COMMERCE . . .

Here is an impression of the new colour scheme in which Cunard Eagle's Britannia, DC-6C, Viscount and Viking fleets are to fly. The previous scheme was illustrated on these pages on September 2. Note the stylish fin motif which replaces the former "E"

per cent of all overhauled P & W JT4s are rejected because of excessive vibration, or that 80 to 100 tail de-icer boots a month on TWA's 707s need repair. A better yardstick for judgment is the optimistic mood of the engineers and maintenance men themselves; their obvious delight with the maintained performance of the big jets and their engines; and their confidence in the ability of manufacturers quickly to devise a "fix" when things go wrong. And in an age when competition to fill jet seats has never been greater, airline technical co-operation is increasing, particularly among the US local carriers operating identical equipment.

What *are* the ailments that afflict US turbine equipment? Firstly, delayed departures due to technical causes are still slightly higher than they are for piston-engined equipment. TWA's experience can be taken to be typical. The 13 per cent departure-delay rate recorded in the first months of jet services has now fallen to the US industry average of 6.5 per cent, but technical delays on its piston-engined fleets are still two percentage points lower.

As reported in the *Aviation Week* account of the ATA meeting, current technical snags with turbine equipment are as follows:—

Boeing 707. Zone temperature controls are recommended to improve temperature distribution in 707 cabins. Three problems have occurred with the main landing gear: tight turns on the ground have shown up low fatigue-resistance of shock-strut cylinders; trunnion support structures have suffered brittle cracking, and there have been a number of cases of leaking strut seals. Tail-unit leading edges have often had to be removed in order to effect repairs on de-icer boots. A TWA aircraft is now flying with instrumented de-icing boots in an attempt to find a solution. Fire-detection system failures average 0.2 per 1,000hr; Nesa-glass windscreen panels failures average 0.67 per 1,000hr. The latter take up to eight hours to replace.

DC-8. Heated windscreen panels on United aircraft have also had a high failure-rate, although this has been reduced from 2.2 per 1,000hr to 0.5 per 1,000hr. The fuel-quantity indicating system failure-rate has been reduced from 4.3 to 0.3 per 1,000hr after an engineering team visited every United station to explain maintenance procedures. Under turning loads, the main undercarriage strut cylinder distorts elliptically, extruding and nibbling the pressure seal and causing leakages. Other problems reported by United are short brake life and a number of difficulties with the engineering of the Freon air-conditioning system.

Convair 880. Reporting on its Convair experience, Delta told the conference that 880 fuel consumption was about 1,000lb/hr greater than anticipated. It is expected to be brought back to the design level after modifications by Convair and General Electric. A big drive is being made on component reliability; this year Delta have released or have projected 95 system modifications, 71 structural, 144 electrical and instruments, 79 powerplant and 87 furnishing.

F-27. Safe-life limitation on the 61 aircraft with unmodified wing centre-sections is 7,600hr; this was described as the "prime problem" with this aircraft. Some operators are to overhaul some of their F-27s in advance of centre sections becoming time-expired. Piedmont Airlines report overhaul costs of 40 cents per passenger-mile against the 18 cents originally anticipated. Snags are reported on air-conditioning systems, water injection, propeller synchronization and a.c. generation, but wheels, tyres and brakes account for nearly half the spare-parts cost of some airlines.

P & W JT3 and JT4 engines. Vibration troubles on overhauled JT4s appear to affect engines with steel compressor sections more than those with titanium sections, and engines are more sensitive to vibration with a Boeing 707 inlet than in a DC-8 installation or with a Pratt & Whitney bellmouth. JT3 engines are apparently not affected. In 420,000 engine hours, 95 JT4s and 73 JT3s have been removed prematurely. PanAm reported the basic causes of premature JT4 removals as inlet guide vane cracking, 15; improper balance, 6; diffuser case cracking, 5; and bearing seal failure, 3. JT3 failures necessitating premature removal were turbine-seal erosion, 9; out-of-balance compressors, 5; bearing failures, 3; and N_2 accessory-drive failures, also 3.

HERALD SERIES 200

SINCE the entry for the Handley Page Herald (page 806) went to press, more information has become available about the Herald Series 200, as it is now known. This is the 42in-stretched version, as ordered by Jersey Airlines; the present Herald, of which three are being built for BEA, becomes the Series 100.

The following information therefore supplements that on page 806 of this special issue:—

Herald Series 200

Powerplant: As 100, except length, 75ft 5in.

Weights: As 100, except zero fuel, 37,000lb; basic operational 24,958lb.

Payload accommodation: As 100, except cabin volume increased; cabin length, 52ft 3in; floor area increased; max seats, 56.

Fuel capacity: As 100.

Performance: Cont cruising speed, 236kt (271 m.p.h.) at 20,000ft and 36,000lb, with a fuel consumption of 184 Imp gal/hr; balanced field length at max take-off weight, sea level, ISA, 4,500ft; landing distance from 50ft, 2,325ft; range A and range B, as for Herald Series 100.

ONLY HALF AN INCH

AWARENESS of the dangers of slush, sharpened by the Munich accident, is now general. In the United States, where NASA have carried out their own original research into the effects of slush on take-off performance, the Federal Aviation Agency has issued draft slush operating rules to the airlines.

These rules are not in force (in any case there is no slush yet) but the FAA propose, among other things, that all jet take-offs should be banned in more than half an inch of slush. The airlines and the pilots are now making comments on this the FAA's proposal. Additional research will be needed before permanent regulations can be enforced.

BOAC'S "DIRECTIONAL FARES"

A NEWSPAPER report last week about a BOAC proposal to introduce "directional" fares, which if implemented could bring radical changes to the IATA fare structure, is believed to have originated in an article published in the November issue of *BOAC Review*. The article outlines the way in which BOAC is planning to develop its North Atlantic business, and the appropriate extract is as follows:—

"The problem is basically economic—the cost of travelling to the USA is at present still beyond the pocket of the average European. For example: whereas it would take, say, a secretary working in New York six weeks' salary to cover the cost of her fare to Europe, it would take her counterpart in Paris or Brussels 16 weeks' salary.

"What is the solution?

"Majority of the world's airlines feel that only IATA, governing body of the world's air carriers, can finally solve the problem. Perhaps by introducing 'directional fares'—which would set fares in ratio to salaries. But an international solution lies in the future. In the meantime, the airlines must find their own solutions."

A BOAC spokesman said last week that the plan was no more than a tentative idea at this stage and would, of course, have to be fully discussed in IATA.

Earlier this month Fiji Airways received the last of the three Heron 1s that it will use on inter-islands services in the Fiji group, to New Hebrides, the Solomons and Tonga

IATA FACTS AND FIGURES FOR 1959

A LARGE part of the information just published in IATA's annual *World Air Transport Statistics** could have been extracted two months ago from the International Civil Aviation Organization document *Digest of Statistics No 10*, prepared and published in the same Montreal building. This does not mean that the IATA publication is valueless—far from it. But we are once again reminded of the good service that ICAO and its member governments give to students of world air transport. Even in this country the MoA is two or three months ahead of BOAC and BEA in publishing full traffic statistics of the corporations' calendar and financial years and, as noted last week, ahead of BIATA also in the publication of scheduled traffic figures for the independents.

But the IATA publication does provide much new information—including some figures for the non-scheduled activities of the British independents who are members of IATA. This is the only place where these details can be found, and they are as follows:—

BRITISH IATA INDEPENDENTS' NON-SCHEDULED TRAFFIC, 1959

	Revenue miles flown × 1,000		Revenue hours flown		Capacity ton-miles × 1,000	
Airwork*	492 int 658 dom	1,150	2,267 int 3,150 dom	5,417	1,910 int 4,810 dom	6,720
Hunting-Clan*	2,080		9,205		15,400	
Skyways†	1,245		6,237		7,060	

*Incorporated into British United Airways as from July 1, 1960. †All international. **Note:** Eagle (now Cunard Eagle) is the only British IATA independent, and actually the only one of IATA's 89 members except LAN Chile, to provide no information about its non-scheduled operations.

Of particular interest in IATA's *World Air Transport Statistics* are aggregate figures for North Atlantic traffic over the decade 1950-59. (There are no results by individual carriers, of which there were 17 in 1959 compared with ten in 1950.) The most spectacular increase, as might be expected, was in economy-class traffic. This rose to 1,008,765 passengers in 1959, an increase of more than 50 per cent on the previous year. Of the total North Atlantic scheduled passenger traffic (1,367,287), economy class accounted for 74 per cent. First-class passengers accounted for 21.5 per cent of the North Atlantic business, and a mere 4.7 per cent were the tourist-class travellers who made their last flight in this class on June 30 last.

Even more remarkable than the growth of economy-class traffic, which after all comes as no surprise, is the great leap forward in the charter business. Nearly 173,000 charter passengers flew across the Atlantic last year, most of them members of "closed groups." This was an increase of 75 per cent on the previous year. This class of passenger-business—a sort of North Atlantic fourth class—is 12½ per cent of the scheduled passenger business, and it is increasing steadily—so much so that, in the opinion of some North Atlantic airlines, it is diverting traffic from the scheduled economy-class services. The year before last, charter passengers were only eight per cent of the total scheduled figure, compared with five per cent the year before that. The proportion has climbed steadily since 1950, when it was less than two per cent of the scheduled figure.

A topical note here is that the European representative of Flying Tiger (an IATA member) announced in London last week "the lowest transatlantic charter rates in the history of the company to recognized groups . . . with pro-rated costs per group probably coming down to as little as £58 for the return flight between London (or Paris) and New York." Lockheed Super Constellations, seating up to 118, would be used in the spring, summer and autumn of next year.

Of course, these transatlantic group charters all have to be approved by the CAB as *bona fide* closed groups. It is not the case, as a spokesman for another transatlantic airline has ruefully remarked, that all people having brown eyes appear to qualify for a group charter.

Just as impressive as the growth of passenger charters is the discovery in the IATA publication that scheduled transatlantic cargo traffic went up in 1959 by 37 per cent to 32,799 tons. Here again there are signs of diversion by charters: chartered IATA cargo on the North Atlantic was 11 per cent of the scheduled total, compared with 4.7 per cent last year. The word "diversion" is perhaps not quite appropriate here, since the figures are all related to the results of IATA members. There are no figures available for the chartered traffic carried across the North Atlantic by non-IATA members, but it is probably sufficient to be partly responsible for the rise in IATA charter business, which, in the long run, will stimulate the reduction of fares on scheduled services.

*1960 edition, published by IATA, 1060 University Street, Montreal 3, P.Q., Canada, price 50 cents or equivalent.

BREVITIES

The first Indian-assembled Avro 748 will, it is reported, fly at Kanpur on January 26, Indian Republic day.

TCA's date for introducing the Vanguard is February 15, following deliveries due to start next week, and following at the rate of one per week until all 23 are delivered.

Mr C. Martin Fox has been appointed a joint managing director of Silver City Airways and Mr Ray V. Baker, general manager of the Northern Division, has been appointed to the board.

Lydd, instead of Manston, is to be the terminal of Silver City's vehicle and passenger ferry service to Ostend from December 1. The return to Lydd is made necessary by trooping and other passenger commitments at Manston.

Convair are offering a shortened Convair 880 with the name "Forty-Niner," derived from its 4,900ft take-off roll. It replaces the Convair Model 60 proposal (page 795). Take-off weight, 135,000lb; "range," 1,000 miles; powerplant, four derated GE CJ-805-3Bs; price, about $1m less than the 880.

A BOAC spokesman confirms that the corporation has received "a tentative approach" from Malayan Airways about the possibility of chartering on a long-term basis from the corporation a Britannia 102. The spokesman confirmed also that though no agreement has yet been signed, the British Hong Kong independent Cathay Pacific has asked BOAC for a chartered Britannia 102 for about five weeks from the middle of next month while Cathay Pacific's Lockheed Electras are at Burbank for modification. The aircraft would be operated by BOAC crews with Cathay Pacific cabin staff.

It is reported that Trans-Texas Airways is negotiating to purchase seven Convair 240s from American Airlines for $130,000 each, with an option on a further 15.

At the request of the Netherlands, signing of the official Eurocontrol agreement—originally expected this month—has been postponed until the first quarter of next year.

Following a hydraulic failure, BOAC Britannia 102 G-ANBC belly-landed at Khartoum Airport on November 11 and was badly damaged. There were no injuries among the 19 passengers and eight crew on board.

A supersonic airliner survey made for the FAA by United Research Inc estimates that the following losses have been incurred in current commercial turbine equipment production: Boeing, $165m (£59m); Convair, $221m (£79m); Lockheed, $75m (£26.8); and Douglas, $247m (£88.3m).

The cost of the two DC-7Cs that Japan Air Lines are having converted to DC-7F configuration by Douglas will be £113,571 per aircraft. The order was placed last month, and the first will be put into service on February 1, 1961, according to a JAL spokesman in London last week. Conversion calls for removal of the normal passenger accommodation, installation of large cargo doors fore and aft, and heavy flooring.

Handed over at Filton on November 8 was the last Britannia for a commercial operator. It was accepted on Ghana Airway's behalf by HE Mr Krobo Edusei, Ghana's Minister of Transport and Communications. Formerly a BOAC Britannia 312 used for flight development work, the aircraft was returned to the production line for modification and is now named "Osagyefo"—one of Dr Nkrumah's courtesy titles meaning "wise one"

ROCKETDYNE ROUND-UP (continued from page 773)

Navaho programme changed. Fortunately, this engine fulfilled the propulsion requirements for the Army's medium-range artillery weapon and, in April 1951, a contract was awarded for its continued development for the Redstone missile. Under the contract terms, the engine was to operate at full capabilities for a duration of 110 seconds. In 1952, this engine entered production, and it flew successfully in August 1953.

This engine has since been termed the "reliable workhorse" by the Army. Through its first 64 launches, covering a seven-year period, it has failed only once (during the third Redstone flight, in 1953). Added recognition of reliability came after its use as the first-stage booster for Explorer I, the first American satellite. The Redstone engine in the Explorer I functioned flawlessly after being in storage for 14 months. Hydyne, a Rocketdyne-developed high-energy fuel consisting of diethylenetriamine and unsymmetrical-dimethylhydrazine was substituted for the normal alcohol/water fuel to provide increased performance. Hydyne has been used in several Explorer space flights where additional performance was necessary. Additional proof of reliability is the fact that this engine will launch the Mercury Astronauts in the first of the West's man-in-space projects.

Atlas The next major rocket project was directed toward the development of an operational ICBM. This was initiated in 1953 by the Air Force with an R & D contract to Convair, as prime contractor. The initial Atlas configuration, a one-and-a-half stage design, was based on a cluster of five 120,000lb engines. The missile was then radically changed, advances in bomb yields made possible significant reductions in the design payload. As a result, the Atlas was scaled down to the present three-engine, one-and-a-half stage configuration. (Many have claimed that this advance in the thermonuclear field had the opposite effect in rocket propulsion by retarding the development of high-thrust booster systems.

Atlas finally specified a jettisonable booster propulsion system of two 150,000lb engines, supplemented by a 60,000lb (80,000lb at altitude) sustainer. Two 1,000lb vernier engines were to provide roll control and ensure accurate thrust termination. The sustainer would be ignited at sea level, and would operate essentially through propellant depletion, requiring an engine burning several times longer than any previous model.

These new engines incorporated chamber gimbals, developed to provide single-engine vector control in any direction. This marked the first time that a gimbal system had been used in a high-thrust engine. A number of problems arose which required expeditious corrective action. Shrouded turbine blades were developed to counter fatigue failure. Improved seals were developed to eliminate the hazards of combustile leakage. New bearing designs were devised to extend bearing endurance. The Atlas vehicle has achieved an outstanding flight record; the propulsion system an even more impressive one. In the first 60 flights, the propulsion system performed successfully 56 times.

Thor/Jupiter In November 1955, the Department of Defense established the requirement for an IRBM with a 1,500 n.m. range. Development of advanced engines for the Army Jupiter and Air Force Thor was directed toward this goal. Work began at Rocketdyne the same month, when preliminary design of the Atlas engine was completed and experimental units were on test. Both IRBM engines were based on the Atlas booster design. R & D engines for both Thor and Jupiter were delivered in mid-summer 1956 for missile-mating firings. This was only seven months after the inception of the programme, but production models of each engine followed within two months. Flight tests started in early 1957, and both missiles have since logged a highly successful series of launches.

The IRBM engines utilized an improved sequence for smoother and more reliable starting, as well as a miniaturized and simplified pneumatic control panel. Both incorporate regeneratively cooled, gimbaled chambers. Bell-type nozzles were first used operationally with these engines. This nozzle configuration provides performance equal to the previous 15°-half-angle conical nozzles, while reducing length and weight.

Jupiter and Thor have also been used to boost many satellite and space missions. As of October 5, Rocketdyne engines have powered the booster stage for 26 out of 29 of the West's successful satellites and space flights.

Major Trends Reliability may be considered as the major aspect in design since it dictates the direction of all other trends. Whenever a design advancement will permit an increase in performance or a reduction in weight, the reliability of the advancement governs its use. Reliability is established in the original design and in subsequent improvements. In the initial design every aspect is analyzed from a reliabilitiy standpoint. Based on engine testing, field reports, and accumulated statistics, a new design is evaluated against problem areas in past designs. Potential weaknesses are determined and eliminated. Component tests are unceasingly analyzed to locate any possible area that can be improved. Reduction in the number of components eliminates potential malfunction areas.

Reliability is recognized as an over-all company effort. In all aspects of design it is considered by the reliability board, which includes all sectors of management, engineering, and manufacturing, and provides direction and control. A special engineering department continuously evaluates the reliability standards of all Rocketdyne engines. In manufacture, improved fabrication techniques and high quality-control standards assure that the final delivered engine will have all its inherent reliability. For example, automatic numerically controlled machines provide great reproducibility, and minimize possible errors in manufacturing components.

Propellants Major advances in performance can be attributed to the use of new propellant combinations. High-energy propellants offer the most amenable method of increasing performance in significant strides. The initial high-thrust engines were designed for lox/water-alcohol (25-75) mixture. The lox/kerosine combination is used in the large engines presently being produced; it has proved to be a highly successful combination from the performance, logistic, and economic standpoints.

The Redstone engine was designed for the lox/water-alcohol combination. To provide increased performance, Hydyne was developed, to be directly substituted for the alcohol-water fuel (no engine design changes were required). Since 1953, non-cryogenic (storable) combinations have been tested to establish their feasibility for distinct applications. Nitrogen tetroxide/hydrazine is typical, and has a relatively high performance. The 400,000lb E-1 engines, as well as most production engines, have been satisfactorily tested with storable combinations at high thrust levels. Lox/liquid hydrogen and liquid fluorine/liquid hydrogen, provide a great increase in performance. Lox/liquid hydrogen is an excellent choice for future design. Fluorine toxicity is avoided, and the high performance offsets to a great extent the hydrogen volume required. Further advances in performance will be achieved in the future; new noncryogenic propellants will be developed, and the possibility exists of developing exotic propellants whereby energy is added by modifying the electron orbital arrangement.

Thrust-chamber design Advancements in chamber design have increased performance and reduced weight and size. Injectors now provide stable combustion, with approximately 100 per cent of theoretical specific impulse. High chamber pressures reduce size and weight, and, for upper-stage engines, permit the use of a high nozzle area-ratio (high performance) without overly increasing size. In early engines a conical nozzle was employed, with regenerative cooling by the fuel. Tubular-walls reduced weight and eased production. Nozzle shape was changed to a lighter bell-type, and subsequent innovations, such as new contours, provided increased performance at all altitudes. The spike nozzles offer further reduction in engine size and weight, and lend themselves to integration with the tank design.

Turbopumps The Redstone engine ultilized a low-speed turbine directly coupled to the pumps. Although pump suction specific speeds were higher than previously obtainable, the limited inducer design technology required that the pump operate at what is now considered a low speed. As a result, an efficient direct-drive turbine had an excessive diameter and weight. Gears were required to provide a compact, high-performance turbopump. Inducer development, the key to higher suction specific speeds, has been supported by continuous testing of improved concepts, and now permits efficient high-speed pump operation. Such a pump can be directly coupled to an efficient high-speed turbine, eliminating the necessity of a geared drive. An additional benefit is a reduction in the required pump inlet head, and hence the missile tank pressure.

Turbine performance has been enhanced by the development of blade alloys that permit operation at higher temperature, to increase power without increasing the gas flow. Packaging of turbopump systems has also undergone considerable changes. In the early designs, flexible propellant lines were employed between the gimballed chamber and the stationary turbopump. In current engines, the higher chamber pressure made large, high-pressure flexible lines undesirable, leading to the mounting of the turbopump on the chamber, with flex lines on the low-pressure inlet side. This was assisted by the reduced size of the high-speed direct-drive turbopumps. Although this change in location increased the gimballed mass, it provided greater overall simplicity and reliability. A dual-turbopump design—a separate unit for each propellant—may allow even better packaging. This arrangement is especially desirable when optimum fuel and oxidizer pump speeds are widely separated (as in hydrogen/oxygen engines). Pump inlets may be upright, permitting direct entry of the propellants, and the turbopumps may be located symmetrically about the nozzle.

(To be concluded)

A North Star of No 426 (Thunderbird) Sqn, RCAF, flying over Toronto. The squadron is based at Trenton, Ont

SERVICE AVIATION

Air Force, Naval and Army Flying News

Australian FAA Whirlwinds

IT was announced in Canberra last week by the Australian Minister for the Navy, Senator J. G. Gorton, that HMAS *Melbourne* would be re-equipped in 1963 with AS helicopters if a suitably priced helicopter suiting all Australian Navy requirements could be found. The announcement indicates that *Melbourne* will be given a new lease of life when her present generation of aircraft, Venoms and Gannets, become obsolete; and it may be regarded as a victory for those who have argued for the retention of the Australian Fleet Air Arm, whose history and possible future prospects were discussed in a *Flight* article —*Australia's Fleet Air Arm: Threatened Demise of a Gallant Service*—on November 4.

Reporting the new decision, an Australian correspondent writes: "It is understood that the order will be for Westland Whirlwinds, as these are comparatively cheap and quickly available. The order will be for more than twenty."

Bomber Group Posts

ON December 19 the two groups of Bomber Command are to have new Senior Air Staff Officers: Air Cdre P. E. Warcup is to become SASO of No 1 Group, at Bawtry, Yorks; and Air Cdre J. E. ("Johnny") Johnson becomes SASO of No 3 Group, at Mildenhall, Suffolk. Both officers have been taking the 1960 course at the Imperial Defence College.

Air Cdre Warcup is an ex-Halton apprentice who won a cadetship to the RAF College, Cranwell. He flew with No 54 Sqn until early in 1939, then was with the Aircraft and Armament Experimental Establishment until May 1940. In June that year, while on operations over Germany, he was shot down and remained a prisoner for the rest of the war. He is a CBE.

Air Cdre Johnson was one of the outstanding fighter pilots of the Second World War, winning three DSOs and two DFCs for "operational prowess, destruction of hostile aircraft, skilful and courageous leadership and gallantry in combat." By the end of the war, he was credited with 38 enemy aircraft destroyed and others damaged. Until recently, he commanded RAF Cottesmore, where the first Victor squadron was formed.

Shahbaz III

DESCRIBED as "the largest air exercise yet carried out by CENTO," Shahbaz III has just ended: the Central Treaty Organization's third air defence exercise, it began last Tuesday and was to last three days. Its purpose has been to provide an opportunity for the air forces of Iran, Turkey, the United Kingdom and the United States to operate together and to exercise the Iranian and Turkish air defence systems. Included among attacking forces were Vulcans from No 617 Sqn and Canberras from the MEAF Light Bomber Wing based at Akrotiri in Cyprus.

"Oldest, Boldest, Slowest"

TWO years' service in Aden with Scottish Aviation Twin Pioneers was completed by No 78 Sqn last Friday. First squadron in the RAF to receive these aircraft, No 78's tasks are to supply and transport Aden Protectorate Levies, carry out reconnaissance patrols and general communications work and evacuate casualties. (Recently, as recorded on this page last week, one of the squadron's aircraft made its first night casevac flight.) The squadron, commanded by Sqn Ldr J. H. Phillips, has as its motto "nemo non paratus" (officially translated as "always ready"). During the past two years it has done nearly 7,000hr flying, carrying 3mlb of freight and 16,610 passengers. With an average age of 35, and flying aircraft which cruise at 100kt in operations over rugged country, its pilots claim to be the "oldest, boldest and slowest" in the RAF.

Groundcrew from the RN Intensive Flying Trials Unit receiving instruction at Blackburn Aircraft, Brough, on Buccaneer maintenance. The lecturer is Mr Walter Blanshard, airframe instructor; the electrics course is taken by Mr J. E. Wood. Members of the service department, they are assisted by CPOs J. T. Driscoll and M. G. Kemp of the RN School of Maintenance

IN BRIEF

Eight more RAF squadrons—Nos 21, 37, 53, 66, 72, 73, 80 and 83—are to receive standards in recognition of their completion of 25 or more years' service.

The adjutant of No 53 Sqn, RAF Abingdon, would be grateful for any news of squadron silver and trophies which have been mislaid in recent years.

Branches of the RAFA raised £15,618 for the RAF Benevolent Fund by their Battle of Britain Week activities last year. This compared with £15,546 in 1958.

The annual reunion of the Air Public Relations Association is being held next Thursday (November 24) at the RAF Club, Piccadilly, London W1, from 6.30 p.m. onwards.

A new edition of the *RAF Athletic and Games Handbook—Winter 1960/1*—has been published by the RAF Sports Board, Air Ministry, London WC1. Its price is 4s.

A detachment from the Helicopter Flight at RAF Khormaksar, Aden, was recently presented with a silver medal commemorating the display its Sycamores gave at the Royal Agricultural Show at Nairobi in Kenya.

The AFC has been awarded to two RCAF officers, Fg Off C. Alexander, a navigator, for landing an aircraft after his pilot had blacked out; and Fg Off C. Batcock, for "a superb forced landing at his home base" when he would have been justified in baling out.

The RCAF has placed a contract with Pye Telecommunications Ltd, through Pye Canada Ltd, for the supply of a Pye ILS for installation at RCAF Trenton, Ont. This is the first installation of a British instrument landing system on the west side of the Atlantic.

Sqn Ldr Fern Villeneuve, leader of the RCAF "Golden Hawks" aerobatic team, was seriously injured recently after forced landing his Sabre following an engine failure. He refused to abandon the aircraft in flight because it was over the town of Newcastle, New Brunswick.

At an inquest on Jnr Tech A. W. Rae, who was killed when he was struck by a Whirlwind rotor blade at Manston on November 2, the pilot, Flt Lt J. F. Strong, said it had been considered impossible for an aircraft of that type to strike personnel on the ground with a blade. He added: "My view is that either the wind, which was gusting at 50 miles an hour, dropped suddenly or possibly there was a defect in that blade."

Straight and Level

WHO'S afraid of the aviation industry of the six European Common Market countries? Of a combined Franco-German threat to Britain's aviation exports?

Well, I was—until the Germans started to toy with the idea of building a Caravelle competitor, in the shape of the Hamburger HFB.314 (pages 805 and 813). I seem to remember recording the British industry's warm approval of this duplication of Common Market effort.

The latest news is that the West German Minister of Economics says his government is ready to negotiate about financial support for the HFB.314. Herr Ludwig Erhard was answering a question in the German Parliament, asking him to comment on reports that the Government would refuse such financial aid because the aircraft might compete with the Caravelle, "which might upset the French."

I believe that the French were rather upset when *we* went ahead with a Caravelle competitor (D.H.121) instead of co-operating with them. I can imagine that a German decision to build the HFB.314 would upset them even more.

Anyway, I would be the last to suggest that a united European Common Market industry avoids wasteful duplication. The more they duplicate themselves out of the market, the better it will be for us.

* * *

How about duplication at home? Are our two big aircraft groups overlapping anywhere? Not yet, at any rate in terms of production. But a British Aircraft Corporation team has been in Australia selling TAA and Ansett on a common fleet of VC11s and BAC-107s. No doubt Hawker Siddeley Group salesmen have been there, too, persuading the Australians to buy a common fleet of Trident Mk 2s and Avro 771s instead. If this is happening in Australia, it is possibly happening in other markets. Can our industry as a whole afford such internecine competition, if that is what this is?

● One of the little crosses *Flight* has to bear is this sort of letter:—

"Dear Sir,

Our attention has been drawn to the fact that, in your recent description of the Scruggs SA.421 Speedliner, reference was made to the fitment of the Haddock goofle switch Type 2000E/WA-1B. We would point out that GOOFLE SWITCH is a Registered Trade Name of this Company, and as such should at all times be spelt with a capital G. We would also point out that the Goofle Switch specified for the Scruggs SA.421 is not Type 2000E/WA-1B, but Type 2000E/WA-1C.

An early correction in your columns would oblige.

Yours etc,
Haddock Engineering (East Smithfield) Ltd."

You can imagine, then, how refreshing it was to receive a letter like the one we printed last week (page 740) from Mr Guy Smith of Bristol Siddeley.

● Did you see the topical TV programme "Near Miss" last Friday evening? It was very well done, I thought. Several million potential air passengers were shown, without frightening them yet without any trace of complacency, how urgently the dangers of collision in the air are being tackled in this country.

If I have any criticism it is that no one is really too disturbed about this country's air traffic control system. It is what goes on in other countries that worries people, and we heard nothing of this.

But I especially congratulate the BBC for mentioning the fact that the Ministry of Aviation refused to allow an air traffic control officer to take part in the programme, "because he is a Civil Servant." Perhaps the MoA thought that a representative of the profession most qualified to speak on our air traffic control might give the impression that all is not for the best in the best of all ATC worlds. You may have noticed that the Guild of Air Traffic Control Officers has remained as quiet as a mouse on the subject of the Queen's near miss. Why? Because someone in the Ministry has told them to pipe down. I hope sincerely that the BBC and the Press in general keeps needling away at the disturbing lack of public accountability so prevalent in high places.

Contempt of the public interest has, of course, reached its zenith in the Air Minister's refusal to publish the report of the Anglo-German commission of inquiry into the Queen's near miss—on the grounds that there is no precedent for publishing reports of military inquiries. Fiddlesticks to that. And fiddlesticks to the Air Ministry S-Man* who, in reply to a perfectly justified Press inquiry, said:—

"*It is not practical* [to paint RAF Comets with fluorescent paint]. *I cannot give the reason, but if you consider that they are more often used as military transports you might guess.*"

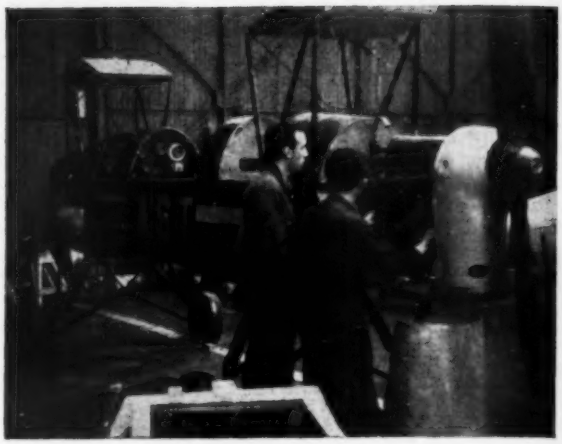
Could coy evasion go further? Every single USAF transport—two or three thousand of them—is painted with fluorescent paint in the interests of safety. Why not all RAF transports?

* Secrecy Man.

● "*The days are long since gone,*" says Mr C. J. Stevens, president of the British Independent Air Transport Association, "*when the air transport problems of this country were looked at in terms of the independents versus the corporations.*"

I must say that the growing lovey-dovey relationship between the independents and the corporations makes me feel mildly embarrassed. If British air transport had a nanny, she would say with a sniff: "Tut tut. What has happened to the old independent spirit that kept BOAC and BEA on their toes, and which stimulated and invigorated Britain's air transport? Have the independents gone soft?"

ROGER BACON



No IX in the Life Goes On series: two D.H.82 Tiger Moths (or is it the D.H.164 Twin Tiger Moth?) joined together so that, like a tram, it can be driven from either end or, like Janus, it looks both ways at once. For further information enrol as a student aircraft engineer at the Airwork Service Training school at Perth. They teach you to fly, too, though not on this

A few weeks ago a *Flight* staff member reported how passengers at Copenhagen airport, daunted by the long walking distances, piled their baggage into push-chairs provided for the kiddies. Now proper scooters have been laid on—what fun it will be for the grown-ups

Commercial Aircraft of the World

IN presenting this fifth annual special survey of the world's commercial aircraft, "Flight" continues a tradition of providing information of value not only to the aircraft manufacturer but to the aircraft operator. Befitting the expansion of the business served by the jet, turboprop and piston-engined aircraft described, this 1960 survey is more extensive than ever before, covering 178 types and variants and extending over 47 pages.

Considerable use has been made of references to past issues of "Flight" in order to provide a bibliography on each type, so that a truly comprehensive historical, engineering and operational background can be obtained. This year, the airline operators' reference drawings first introduced twelve months ago are increased in number and are more detailed in the information that they provide. An explanation of their special intent is given on page 810. Particularly indicative of a current air transport trend are new drawings of three really large freighters, the Canadair CL-44D4, Short Britannic and Vickers Super VC10.

Many of the types which feature in this section have previously had their engineering anatomies laid bare in the cutaway drawings which have been a feature of previous descriptions; reference to the issues in which these appeared is included with the operators' drawings. It must not be inferred from this that engineering information on new types is lacking here; four new turboprops and four new jet transports are the subject of double-page "Flight" cutaway drawings, as indexed on page 827. Those showing the Convair 600 and Vickers Super VC10 depict subsonic transport aircraft design, both aerodynamic and engineering, at its most advanced.

Aircraft are presented in alphabetical order of manufacturer, but an alphabetical reference by aircraft name has been included at the end of the survey on page 827.

EXPLANATORY NOTES: Information is given in standardized form and has, wherever possible, been checked by the manufacturer concerned. In the data tables "cabin volume" and "maximum usable floor area" are exclusive of the flight deck; "baggage and freight volume" is exclusive of the passenger cabin, and "weight less fuel and payload" is the weight of the aircraft otherwise ready for service. Types of less than 8,000lb max weight are not included.

Payload-range performance is quoted on a theoretical no-reserves basis for the purpose of better comparison. Range with maximum payload (range A) and ultimate range with maximum fuel (range B) are stated for operations in still-air, ISA conditions at optimum speeds and altitudes. The shape of the payload-range curve is finally defined by giving the payload that can be carried with maximum fuel.

Cost-range curves are not included, but wherever possible basic new price including standard furnishings, radio, navaids, autopilot (but no spares or ground equipment) or used prices have been given.

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Index by Aircraft Page 827

AERFER *Industrie Meccaniche Aeronautiche Meridionali Aerfer, Corso Malta 30, Naples, Italy.*

Ae 150 A model of this 35,000lb transport project, which is to be powered by two 2,660 e.h.p. Rolls-Royce Dart RDa.10s, was displayed at the 1959 Paris Show but no further details have been forthcoming and it must be presumed that the project has been shelved. *Flight* reference: November 20, 1959.

AGUSTA *Costruzioni Aeronautiche Giovanni Agusta, Cascina Costa, Gallarate, Milan, Italy.*

A-Z-8 Two versions of this four-engined transport (Alvis Leonides piston engines) are offered, the A-Z-8N and the A-Z-8P, respectively 22 passengers (two abreast) non-pressurized, and 30 passengers (two-abreast) pressurized.

The A-Z-8N prototype first flew on June 9, 1958. The type falls into the DC-3 replacement category, and it is offered for military as well as for civil use "where safety, minimum operating cost, and medium range are primary considerations."

The following data, converted from metric figures, apply to non-pressurized and pressurized versions as denoted by (N) or (P):—

Powerplant: Alvis Leonides 531 of 640 b.h.p. (P), or Leonides 502/5 of 540 b.h.p. (N), driving de Havilland three-blade 9ft model 13250 propellers.

Dimensions: Span, 86ft (P), 83ft 8in (N); length, 66ft 10in (P), 63ft 9in (N); height empty, 21ft 8in (P), 21ft 7in (N); wing area, 743 sq ft (P), 719 sq ft (N); aspect ratio, 9.95 (P), 9.78 (N).

Weights: Max take-off, 26,450lb (P), 24,900lb (N); landing, 25,130lb (P); 23,810lb (N); zero fuel, 23,700lb (P), 20,570lb (N); weight less fuel and payload 17,745lb (P), 16,200lb (N); max payload, 5,950lb (P), 4,360lb (N).

Payload accommodation: Cabin volume, 1,260 cu ft (P); 987 cu ft (N); baggage and freight volume, 242 cu ft (P), 194 cu ft (N); cabin length, 32ft 3in (P and N); max cabin width, 7ft 9in (P), 5ft 5in (N); max cabin height, 6ft (P), 6ft 1in (N); max usable floor area, 192 sq ft (P), 168 sq ft (N).

Fuel capacity: 688 Imp gal (P and N) (826 US gal).

Performance: Cont cruising speed (P), 205kt (236 m.p.h.) at 10,300ft at 24,250lb; (N) 198kt (230 m.p.h.) at 11,300ft at 22,045lb; corres fuel consumption, 0.55lb/h.p./hr (P and N), balanced field length, max take-off weight, over 50ft, SL, ISA, 1,690ft (P), 1,750ft (N); at SL, ISA+15°C, 1,820ft (P), 1,935ft (N); at 5,000ft, ISA, 2,230ft (P), 2,310ft (N); max landing distance, sea level, from 50ft, 2,360ft (P), 2,280ft (N); range A (max payload), (P) 778 n.m. (895 st.m.), (N) 1,210 n.m. (1,390 st.m.); range B (max fuel), (P and N) 1,445 n.m. (1,680 st.m.); corres payload, (P and N) 18 passengers or 3,680lb.

AIRCO This consortium of de Havilland, Hunting and Fairey, formed in January 1958 to produce the D.H.121 Trident, came to an end in June this year when it became an anomaly within the new structure of the British aircraft industry. The Trident is described on page 798.

AIRSPEED This company, which designed the AS.57 Ambassador (Elizabethan), was taken over by the de Havilland Aircraft Co Ltd in 1948, and was merged with that company in 1951. The Ambassador is described under de Havilland on page 799.

ARMSTRONG WHITWORTH *Sir W. G. Armstrong Whitworth Aircraft Ltd, Baginton, Coventry, Warwickshire. (Member of the Hawker Siddeley Group.)*

AW.650 Argosy The Argosy is aimed at the big potential air freight business. It is the only pressurized turboprop freighter (four Darts) designed from the outset for civil use, and it is also the only freighter with a swing nose and a swinging aft end to permit the most rapid possible loading facilities.

The first provisional contract for Argosies was announced on February 23, 1959, by the American all-cargo line, Riddle. In June this year the order for five aircraft was re-negotiated when Riddle received a contract for participation in the MATS Logair cargo service and is likely to be extended to seven aircraft. Another provisional order for two Argosies, from Trans Arabia Airways and placed in March is understood to have lapsed. The first flight was on January 8, 1959, at Bitteswell, and six aircraft were flown in nine months. Ten have been built. Certification testing was completed in September by when it had been confirmed that financial assistance would be made available by the Government for development. Basic price, completely equipped, £465,000.

An order for 56 AW.660s (the military version of the Argosy) for RAF Transport Command will be of considerable value to the civil production programme.

Cutaway drawing, pages 786-787. *Flight* references: March 4, 1960, March 18, July 8, August 5, August 26, and October 17, 1958.

Powerplant: Four Rolls-Royce Dart 526 (RDa.7/2) of 2,100 e.s.h.p. each, driving Rotol Type R.186/4-30 11ft 6in propellers.

Dimensions: Span, 115ft; length, 86ft 9in; height empty, 27ft; wing area, 1,458 sq ft.

Weights: Max take-off, 88,000lb; landing, 80,000lb; zero fuel, 76,000lb; capacity payload, 28,000lb; weight less fuel and payload, 48,000lb.

Payload accommodation: Cabin volume, 3,680 cu ft; passengers' baggage volume, 182 cu ft; cabin length, 46ft 10in; max width, 11ft 8in; max height, 8ft 9in; max usable floor area, 426 sq ft; dimensions of largest doors, 6ft 8in × 8ft 8in; max seats, 83 at 32in pitch.

Fuel capacity: 3,300 Imp gal (3,960 US gal).

Water-methanol capacity: 137 Imp gal (164 US gal).

Performance: Cont cruising speed, 227kt (260 m.p.h.) at 21,500ft and 77,000lb; corres consumption 0.089 n.m./lb; balanced field length, max take-off weight, SL, ISA, 4,650ft; at SL, ISA+15°C, 4,650ft; at 5,000ft ISA, 6,000ft; landing distance from 50ft, 5,800ft; range A (max payload), 600 n.m. (690 st.m.); range B (max fuel), 2,171 n.m. (2,500 st.m.).

AW.670 Air Ferry This project is a variant of the Argosy, intended for car-ferry operations or for short haul, very high density (126 seats) passenger operations. As the latter it is designated **AW.671 Airbus.** It has a bigger, non-pressurized fuselage. Data which differ from the Argosy are as follows:—

Payload accommodation: Cabin volume, 1,058 cu ft upper deck, 4,260 cu ft lower deck; baggage volume, 250 cu ft; cabin length, 42ft; max width, 15ft; max height, 7ft; max usable floor area, 610 sq ft; dimensions of largest door 7ft × 15ft; max seats, 126.

Performance: Cont cruising speed, 237kt (272 m.p.h.) at 10,000ft and 75,000lb; corres fuel consumption, 0.065 n.m./lb; balanced field length, max take-off weight, SL, ISA, 4,050; at SL, ISA+15°C, 4,350ft; at 5,000ft, ISA, 5,500ft; landing distance from 50ft, 2,700ft; range A (max payload), 460 n.m. (530 st.m.); range B (max fuel) 1,620 n.m. (1,860 st.m.); corres payload 8,800lb; corres cruise speed, 233kt (268 m.p.h.).

ANTONOV One of the USSR State Aircraft industry's chief designers, Oleg Konstantinovich Antonov, has given his name to four transport aircraft designs for service with Aeroflot, as follows:—

An-2 The prototype of this ubiquitous single-engined biplane transport flew in 1947, and it is said that more than 2,000 have been built for military and civil use. The standard 8-12 seater is an An-2P, powered by one ASh-62IR radial engine of 1,000h.p. Variants are the An-2S (agricultural), An-2V (floaplane, Antonov design number An-6), and An-2SA (high altitude met, design number An-4). Brief data on the standard An-2P are as follows:—

Powerplant: One ASh-62IR piston engine of 1,000 h.p., driving a four-blade constant-speed propeller.

Dimensions: Span, 59ft 7in; length, 42ft.

Weights: Max take-off, 11,600lb.

Payload accommodation: Seats for 8-12 passengers.

Performance: Cruising speed, 107kt (124 m.p.h.); minimum speed, 35kt (40 m.p.h.); landing run, 500ft approx.

An-10A A standard Aeroflot transport, the An-10A is the production version of the An-10, which first flew early in 1957. The An-10A has soft tyres and a four-wheel bogie undercarriage to permit it to operate from grass strips. There is a military aft-loading version.

Powerplant: Four Ivchenko AI-20 turboprops of 4,000 e.s.h.p. each, driving four-blade propellers of about 14ft 9in diameter.

Dimensions: Span, 124ft 8in; length, 121ft 4in; height, 32ft 1in; wing area, 1,293 sq ft.

Weights: Max take-off, 121,500lb; capacity payload, 32,000lb; fuel weight, 22,600lb.

Payload accommodation: Cabin, 7,840 cu ft; cabin max height, 108in; cabin width, 13ft 6in; baggage and freight, 1,483 cu ft; max seats, 126.

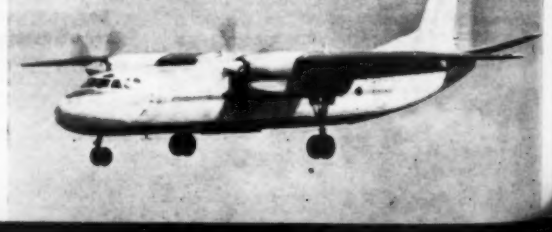
Fuel capacity: 2,800 Imp gal approx.

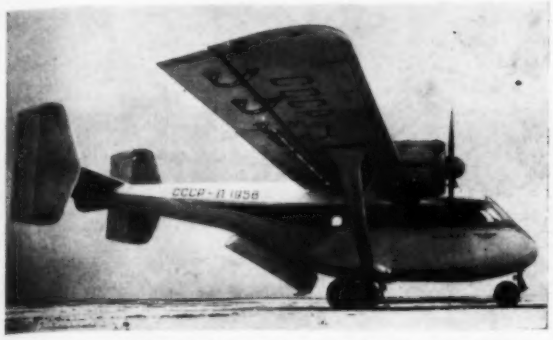
Performance: Cont cruising speed, 345kt (395 m.p.h.) at 26,000ft; take-off run, 2,130ft to 2,300ft; landing run, 1,640ft; range (take-off to landing) with 32,000lb payload, one hour fuel reserves, 1,080 n.m. (1,240 st.m.); range with 23,000lb payload, one hour fuel reserves, 1,670 n.m. (1,925 st.m.); range with 18,600lb payload, one hour fuel reserves, 1,850 n.m. (2,130 st.m.).

An-14 Pchelka ("Bee") This light utility transport, powered by two 260 h.p. piston engines, is comparable with the Short Skyvan, though it is smaller. It is in Aeroflot service. It first flew on March 15, 1958. The field performance claimed for the An-14 puts it in the STOL class, and it has a minimum speed claimed to be no more than 27kt (31 m.p.h.). It appears to have seating accommodation for six people, including one pilot. Large rear-loading doors are fitted.

Powerplant: Two Ivchenko AI-14R piston engines of 260 b.h.p., driving two-bladed 9ft 4in propellers.

Left, Agusta A-Z-8 (Alvis Leonides 502/5 piston engines). Right, Antonov An-24 of Aeroflot (Ivchenko 2,000 h.p. turboprops)





Antonov An-14 "Bee" of Aeroflot (two AI-14R piston engines)

Dimensions: Span, 65ft; length, 36ft; height, 13ft 10in; wing area, 474 sq ft; aspect ratio, 9.
Weights: Take-off, 6,615lb; max permitted take-off, 7,055lb; payload, 1,320lb.
Payload accommodation: Typically 6 seats.
Performance: Max speed, 124kt (143 m.p.h.); cruising speed, 113kt (130 m.p.h.); take-off run, 130ft; landing run, 195ft; landing speed, 36kt (41 m.p.h.); min speed, 27kt (31 m.p.h.); rate of climb, 835ft/min, or 235ft/min on one engine; max range, 540 n.m. (620 st.m.).

An-16 Projected as a stretched development of the An-10A, this type does not seem to have materialized.

An-24 The first reference to this new feederliner appeared in *Flight* of June 17. Y. Loginov, head of Aeroflot, was reported as having stated that the type was intended to replace piston-engined aircraft on domestic routes. The report ran: "It will carry 32 passengers in the standard version and 40 in a high-density configuration at a cruising speed of up to 326 m.p.h. Range is said to be 900-1,240 miles, and take-off distance 500m." When a new picture was published in our issue of August 19 it was stated that take-off run would not exceed 1,000ft. Important additional information, particularly on construction, appeared in our issue of November 4.
Powerplant: Two Ivchenko turboprops of 2,000 s.h.p.

AVIA *Ceskoslovenské Závody Automobilové A Letecké, Palackého Nam 4, Prague 2.*
Manufacturers of the Avia 14 (Il-14M): see Ilyushin.

AVIATION TRADERS *Aviation Traders (Engineering) Ltd, 21 Wigmore Street, London W1.*

ATL-98 Carvair This is a modification of the DC-4, 10 of which are to be produced for Channel Air Bridge, a British United Airways Company. This operator has wanted an aircraft with four engines, capacity for five cars and 25 passengers, long range, cheaper operating costs than the Bristol Freighter, and cheap to buy new. The answer was a conversion of the DC-4 involving a new nose and a new fin. It will be ready for service in the late summer 1961 on the long-haul vehicle ferry routes for which permission has now been granted. The first flight is expected in February or March next year. Basic price: £150,000.
Flight references: June 19, 1959 and June 24, 1960.
Powerplant: Four P & W Twin Wasp R2000-7M2 of 1,450 b.h.p. each, driving Hamilton Standard Hydromatic 13ft propellers.
Dimensions: (see also DC-4, *Flight*, November 20, 1959, page 606). Length, 102ft 7in; height empty, 30ft.
Weights: Max take-off, 73,800lb; landing, 64,170lb; capacity payload, 17,176lb (car ferry), 17,635lb (long-range freighter); weight less fuel and payload, 41,824lb (car ferry), 41,365lb (long-range freighter).
Payload accommodation: Cabin volume, 4,500 cu ft; baggage volume, 151 cu ft; cabin length, 80ft 2in; max width, 9ft 8in; max height, 6ft 9in; max usable floor area, 665 sq ft; dimensions of largest door, 81in × 81in; max seats (subject to ARB requirements), 84; cars, 4 or 5 plus rear seats for 25.
Fuel capacity: 2,993 Imp gal (3,600 US gal).
Performance: Cont cruising speed, 180kt (207 m.p.h.) at 10,000ft and 65,000lb; corres consumption, 1,250lb/hr; balanced field length, max take-off weight, SL, ISA, 5,300ft; SL, ISA+15°C, 5,950ft; at 5,000ft, ISA, 7,100ft; landing distance from 50ft (max weight), 2,800ft; range A (max payload), 1,850 n.m. (2,130 st.m.); range B (max fuel), 2,870 n.m. (3,310 st.m.); corres payload, 10,200lb; V_{NE}, 200kt IAS; V_{NO}, 180kt IAS; V_{SO}, 73kt EAS.

AVRO *A. V. Roe & Co Ltd, Greengate, Middleton, Manchester (member of the Hawker Siddeley Group).*

Avro 652A Anson Introduced in 1935, a total of 11,020 Ansons were built, mainly for military communications work. There are 43 still in commercial service, seating 6-9 passengers. Powerplant is two Armstrong Siddeley Cheetah XV radial engines of 420 h.p.

Avro 685 York C.1 Introduced in 1942, the York was the transport development of the famous wartime Lancaster, the fuselage being the main structural modification. Of 257 built for the RAF, 21 continue in civil use—almost exclusively as freighters—with British independents and Middle East operators. *Flight* reference: August 17, 1944, and November 20, 1959.
Powerplant: Four Rolls-Royce Merlin 502 of 1,610 b.h.p. each, driving DH 13ft three-bladed propellers.
Dimensions: Span, 102ft; length, 78ft 6in; height empty (tail down), 20ft; wing area, 1,297 sq ft.
Weights: Max take-off, 70,000lb; landing, 65,000lb; zero fuel, 50,000lb; capacity payload, 20,000lb; weight less fuel and payload, 42,000lb.
Payload accommodation: Cabin volume, 2,450 cu ft; cabin length, 54ft; max width, 8ft; max height, 8ft; max usable floor area, 350 sq ft; dimensions of largest doors, 7ft 8¼in × 6ft 3½in (forward edge), 7ft 8¼in × 5ft 4½in (rear edge); max seats, 24.
Fuel capacity: 2,478 Imp gal (2,976 US gal).
Performance: Cont cruising speed, 183kt (210 m.p.h.) at 10,000ft and 61,000lb; corres fuel consumption, 0.45lb/b.h.p./hr; balanced field length, max take-off weight, SL, ISA, 5,750ft; at SL, ISA+15°C, 6,600ft; at 5,000ft ISA, 7,900ft; landing distance from 50ft, 4,600ft; range A (max payload), 1,215 n.m. (1,400 st.m.); range B (max fuel), 2,350 n.m. (2,700 st.m.); corres payload, 11,600lb; corres cruise speed 183kt (210 m.p.h.) at 10,000ft.

Avro 688 Super Trader Developed from the Avro Tudor 4B, the Super Trader proved a successful passenger-cargo transport in Air Charter service but is now superseded and none is flying.
Flight references: February 26, 1954, and November 20, 1959 (technical data).

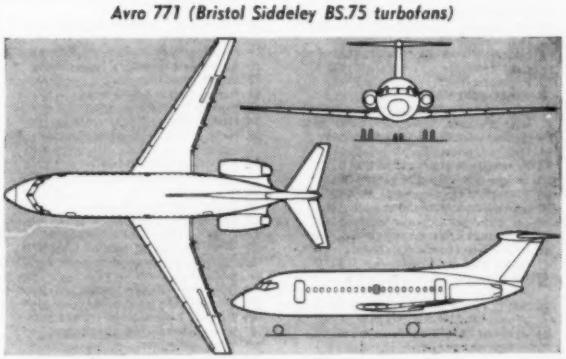
Avro 748 Announced on January 9, 1959, the 748 is the latest British entry in the DC-3 replacement market. Like its main competitors the Handley Page Herald and the Fokker Friendship, it is powered by two Rolls-Royce Dart turboprops. The RDa.6-powered version is standard but a Series 2 aircraft, powered by RDa.7s, is also available particularly for operation in hot climates and at high altitudes. The prototype first flew on June 24. An initial production batch of twelve aircraft is well under way and plans have recently been announced to increase production to 60 aircraft. Orders have been received from two British independents, Skyways (3) and BKS (5); the Indian Government is building the 748 under licence for the Indian Air Force and three Avro 748 Series 2s have been ordered by Aden Airways. Basic price: Avro 748 Series 1, £176,000; Avro 748 Series 2, £196,000. Engineering cutaway drawing, page 784. *Flight* references: May 8, 1959, September 11, 1959, April 22, 1960, May 6, 1960, July 29, 1960, September 2, 1960.

Avro 748 Series 1
Powerplant: Two Rolls-Royce Dart RDa.6 Mk 514 turboprops of 1,740 e.h.p. each driving Rotol 12ft four-blade propellers.
Dimensions: Span, 95ft; length, 67ft; height empty, 24ft 10in; wing area, 795 sq ft.
Weights: Max take-off, 33,000lb; landing, 33,000lb; zero fuel, 29,430lb; capacity payload, 9,986lb (40 seats); weight less fuel and payload, 19,444lb.
Payload accommodation: Cabin volume, 1,990 cu ft; baggage and freight volume, variable; cabin length, 46½ft; max width, 8ft 1in; max height, 6ft 4in; max usable floor area, 296 sq ft; dimensions of largest door, 54in × 48in; max seats, 48 at 32in pitch.
Fuel capacity: 1,140 Imp gal (1,369 US gal).
Water-methanol capacity: 60 Imp gal (72 US gal).
Performance: Typical cruising speed, 230kt (265 m.p.h.) at 20,000ft and 32,000lb; corres fuel consumption, 0.189 n.m./lb; balanced field length, max take-off weight, SL, ISA, 3,500ft; at SL, ISA+15°C, 3,750ft; at 5,000ft, ISA, 4,750ft; landing distance from 50ft, SL, at max take-off weight, 2,190ft; range A (max payload), 580 n.m. (670 st.m.); range B (max fuel), 1,610 n.m. (1,854 st.m.); corres payload, 4,450lb; corres cruise speed, 230kt (265 m.p.h.); V_{NE}, 270kt IAS; V_{NO}, 200kt IAS; V_{SO}, 70kt EAS.

Avro 748 Series 2
Powerplant: Two Rolls-Royce Dart RDa.7 Mk 531 turboprops of 2,105 e.h.p. each driving Rotol 12ft four-bladed propellers.
Dimensions: As Avro 748 Series 1.
Weights: Max take-off, 36,000lb; max landing, 35,500lb; zero fuel, 30,330lb; capacity payload, 9,986lb (40 seats); weight less fuel and payload, 20,344lb.
Payload accommodation: As Avro 748 Series 1.
Fuel capacity: As Avro 748 Series 1.
Water-methanol capacity: As Avro 748 Series 1.
Performance: Typical cruising speed, 252kt (290 m.p.h.) at 25,000ft and 34,000lb, corres fuel consumption 0.201 n.m./lb; balanced field length (max take-off weight, SL, ISA), 3,510ft; at SL, ISA+15°C, 3,780ft; at 5,000ft ISA, 4,630ft; range A (max payload), 1,050 n.m. (1,210 st.m.); range B (max fuel), 1,760 n.m. (2,026 st.m.); V_{NE}, 270kt IAS; V_{NC}, 225kt IAS; V_{SO}, 74kt EAS.

(*Continued on page 788*)

Avro 771 (Bristol Siddeley BS.75 turbofans)



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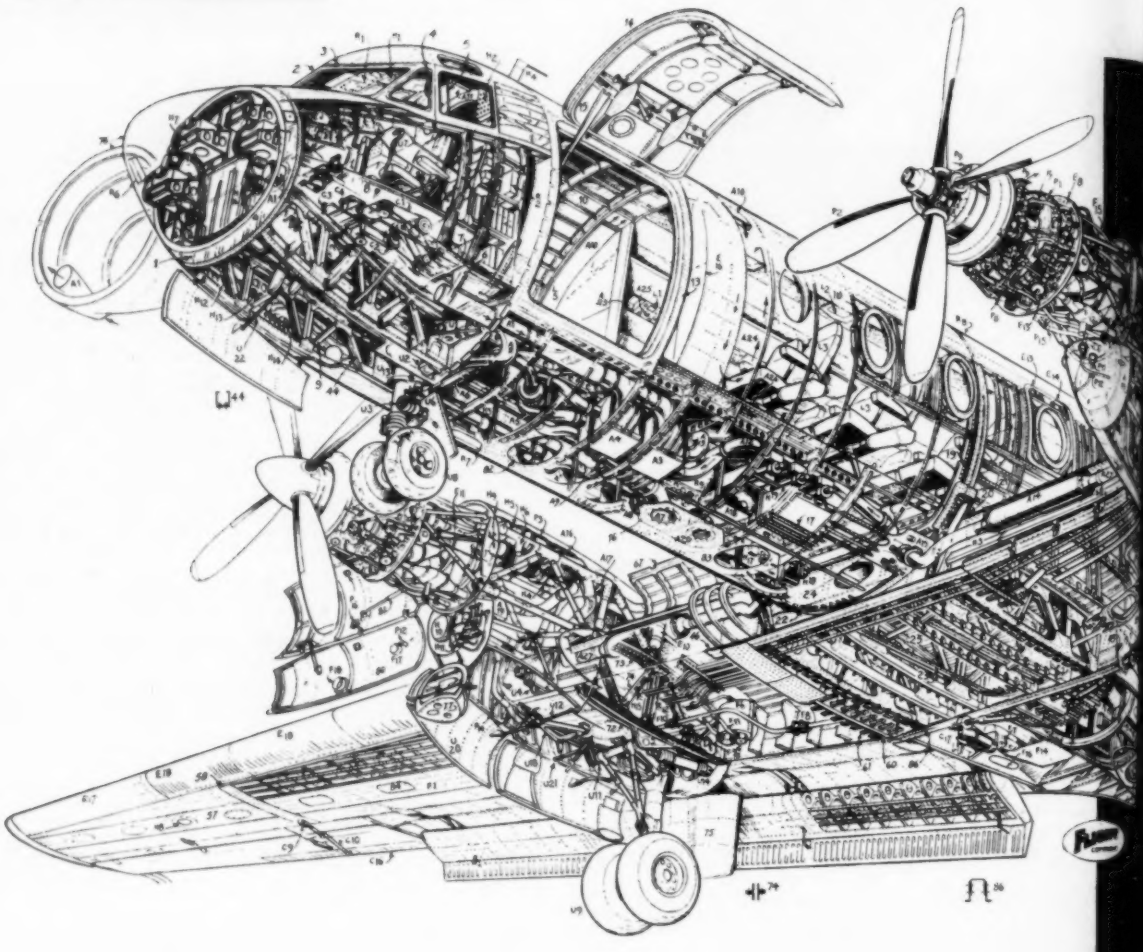


AVRO 748 SERIES 1

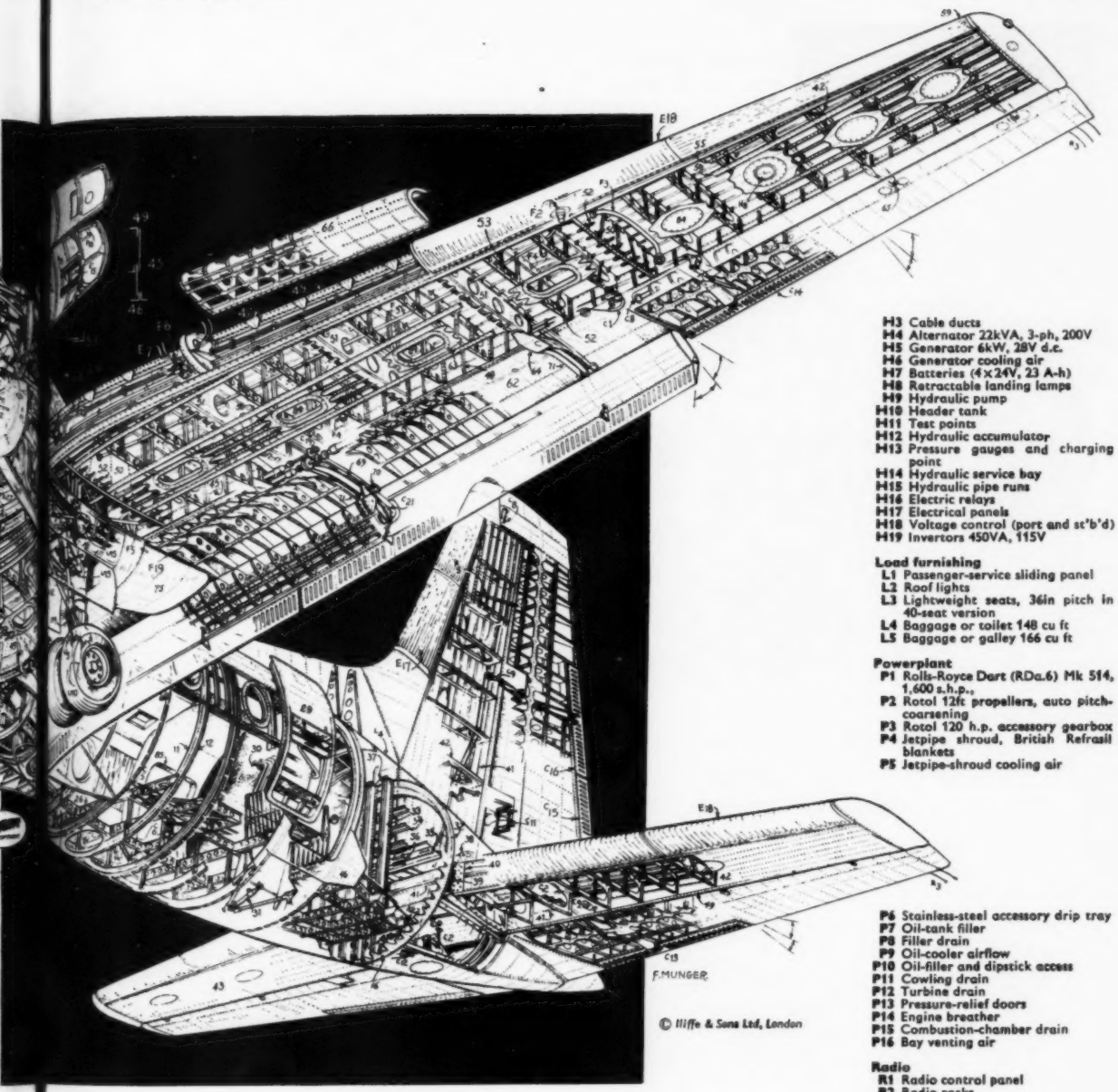
Reference: page 783

Structure

1 Front pressure bulkhead
2 Electrically heated gold-film windscreen
3 Forged windscreen frame
4 DV Panel
5 Pull-in-and-slide window
6 Heavy frames terminate at pressure floor
7 Pressure floor
8 Flight-deck floor
9 Heavy braced structure, supporting pressure floor and nose gear
10 Continuous Z-section stringers
11 Uncut frames
12 Frame/skin segment plates
13 Single-pressing door frames
14 Freight and crew door 48in × 54in
15 Spring-balanced door
16 Doubler plates
17 Stringers doubled up in this area
18 Window-retaining clamps (windows 19in by 13in)
19 Fabricated fuselage/wing main frames
20 Wing/fuselage joint (forging and plate, multi-bolt fixing)
21 Frames bolted to main ribs
22 Stringer carry-through fitting
23 Fuselage inter-spar skin support
24 Spars form pressure boundary
25 Top skin forms pressure boundary
26 Floor-support structure
27 Diagonals brace seat rails for axial loads
28 Honeycomb-sandwich floor panels (75lb/sq ft)
29 Passenger door 62in by 30in
30 Retracted airstairs (optional)
31 Stair-operating ram
32 Rear pressure bulkhead
33 Vertical stiffeners, front face
34 Horizontal stiffeners, aft face
35 Heavy beam carries bottom fin fixing
36 Fin fixing (swing link)
37 Forward top fin fixing
38 Aft top fin fixing
39 Front tailplane fixing
40 Spar joint plate
41 Crack-limiting mid-web joint
42 Warren-braced ribs at hinges
43 Tailplanes interchangeable port and starboard
44 Built-up fail-safe braces
45 Crack-limit joint at 67% depth
46 Double L-section bottom boom
47 Boom stabilizing brackets
48 Web stiffeners
49 Single L-section boom
50 Tank end ribs
51 Tank baffle ribs
52 Stringer carry through
53 Rib safe with any tie broken
54 Stringer/rib tie
55 Extruded Z-section
56 Extruded T-section
57 Skin in crack-limiting panels
58 Skin butt-joint
59 Tip NACA 4412; 18 swg bottom skin, 16 swg top
60 Main root rib NACA 23018; 14 swg bottom skin, 10 swg top
61 Stringer joint plates
62 Rear spar inspection
63 Inspection-hole doubler
64 Doublers at flap tracks
65 Fail-safe hinge brackets
66 Detachable leading edge
67 Hinged leading edge
68 Leading edge fasteners
69 Flap track
70 Flap/rib bridge-piece
71 Ribs take load on track failure
72 Back-to-back channel section over skin
73 Back-to-back L-sections
74 Built-up fail-safe bracing
75 Hinged for flap access
76 Hinged nose (battery access)
77 Hinged fairing
78 Removable side and top panels
79 Outboard panels only shown
80 Outboard panels only shown
81 Cowling stays
82 Inspection, cabin air
83 Inspection, electrics bay
84 Inspection, tank and wing
85 Baggage and emergency door 25in by 49in
86 Main centre-section rib

Cabin-air system

A1 Cooling-air intake
A2 To cabin via non-return valve
A3 Heat exchanger (normal system)
A4 Heat exchanger (cold air system)
A5 Cold-air unit
A6 Water separator on delivery to riser
A7 Cooling-air outlet
A8 Pressure dump-valve (manual)
A9 Temperature control valve
A10 Cabin-air riser
A11 Flight riser, radio cooling
A12 Compressor to heat exchanger and temperature control
A13 Heat exchanger to temperature control



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A14 Compressor delivery silencer
A15 Non-return-valve
A16 Godfrey cabin-air blower
A17 Spill-valve and outlet
A18 Sensing and control unit
A19 Compressor flush intake
A20 Discharge valve (4.4lb/sq in)
A21 Discharge valve and inward venting
A22 Safety valve (4.7lb/sq in)
A23 Cabin-air distribution duct
A24 Circulation round wall before delivery to cabin
A25 Individual air louvres
A26 Extraction to below floor
A27 Compressor delivery

Controls
C1 Aileron controls
C2 Elevator controls
C3 Throttle
C4 H-p. cock and feathering
C5 Control rods under floor
C6 Cable tensioners
C7 Control-run pressure seal
C8 Mass balance
C9 Trim screwjack
C10 Duplicated control rods
C11 Torsion bars, rudder spring-tab
C12 Rudder control
C13 Geared servo
C14 Geared trim
C15 Spring-tab
C16 Trim
C17 Electric flap motor (manual emergency)
C18 Duplicated torque-tubes
C19 Interconnecting chain and sprockets
C20 Flap-operating cable
C21 Tab-operating mechanism

Emergency Systems
E1 Compressor bleed to pneumatic de-icing
E2 De-icing air filter
E3 De-icing suction
E4 De-icing pressure
E5 Discharge from venturi
E6 Solenoid distributor valve
E7 Connectors to boots
E8 Firewall Zone 1
E9 Firewall Zone 2
E10 12lb double-headed fire bottle each nacelle
E11 Fire-suppression to Zones 1 and 2
E12 Fire-suppression cross-feed
E13 Pressure-locked outward-opening emergency exit
E14 External handle
E15 Fire-access panels
E16 Ice-protection strip
E17 De-icing boot (spanwise)
E18 De-icing boot (chordwise)

Fuel system
F1 Integral tanks (1,150 gal total)
F2 Gravity filler
F3 Vent
F4 Contents unit
F5 Feed to collector tanks
F6 Collector tank (5 gal)
F7 Booster pumps
F8 Cross-feed cock
F9 Ground service cock
F10 L-p. cock
F11 Feed to engine
F12 Fuel heater
F13 L-p. filter
F14 38/62% water/methanol tanks, 30 gal each side
F15 Water/methanol feed
F16 Water/methanol pump access
F17 Fuel-heater air exit
F18 Fuel-filter access
F19 Pressure fuelling point

Hydraulic and Electric power
H1 Electrical control panel
H2 Circuit breakers
H3 Cable ducts
H4 Alternator 22kVA, 3-ph, 200V
H5 Generator 6kW, 28V d.c.
H6 Generator cooling air
H7 Batteries (4×24V, 23 A-h)
H8 Retractable landing lamps
H9 Hydraulic pump
H10 Header tank
H11 Test points
H12 Hydraulic accumulator
H13 Pressure gauges and charging point
H14 Hydraulic service bay
H15 Hydraulic pipe runs
H16 Electric relays
H17 Electrical panels
H18 Voltage control (port and st'b'd)
H19 Invertors 450VA, 115V

Load furnishing
L1 Passenger-service sliding panel
L2 Roof lights
L3 Lightweight seats, 36in pitch in 40-seat version
L4 Baggage or toilet 148 cu ft
L5 Baggage or galley 166 cu ft

Powerplant
P1 Rolls-Royce Dart (RDa.6) Mk 514, 1,600 s.h.p.,
P2 Rotol 12ft propellers, auto pitch-coarsening
P3 Rotol 120 h.p. accessory gearbox
P4 Jetpipe shroud, British Refrasil blankets
P5 Jetpipe-shroud cooling air
P6 Stainless-steel accessory drip tray
P7 Oil-tank filler
P8 Filler drain
P9 Oil-cooler airflow
P10 Oil-filler and dipstick access
P11 Cowling drain
P12 Turbine drain
P13 Pressure-relief doors
P14 Engine breather
P15 Combustion-chamber drain
P16 Bay venting air

Radio
R1 Radio control panel
R2 Radio racks
R3 Static discharge wicks
R4 VHF aerial
R5 ILS VOR aerial
R6 Glide slope aerial
R7 Marker aerial
R8 ADF Loop aerial (top fuselage)
R9 ADF Sense aerial

Undercarriage
U1 Nose-leg pivot
U2 Nose-leg ram
U3 Steering cylinder
U4 Up-lock
U5 Up-lock pin
U6 Steering control valve
U7 Steering control
U8 Tyres 8.50×10
U9 Tyres 10.75×14
U10 Maxaret brakes
U11 Main-leg pivot
U12 Door operating links
U13 Down-lock
U14 Main-leg ram
U15 Preclosing door-operating cam plate (fixed)
U16 Cam follower rod
U17 Operating lever for (U16) rotates with leg pivot
U18 Door operating idler
U19 Pick-up for door idler
U20 Preclosing forward doors
U21 Linkage disconnected, door open
U22 Leg-operated door mechanism

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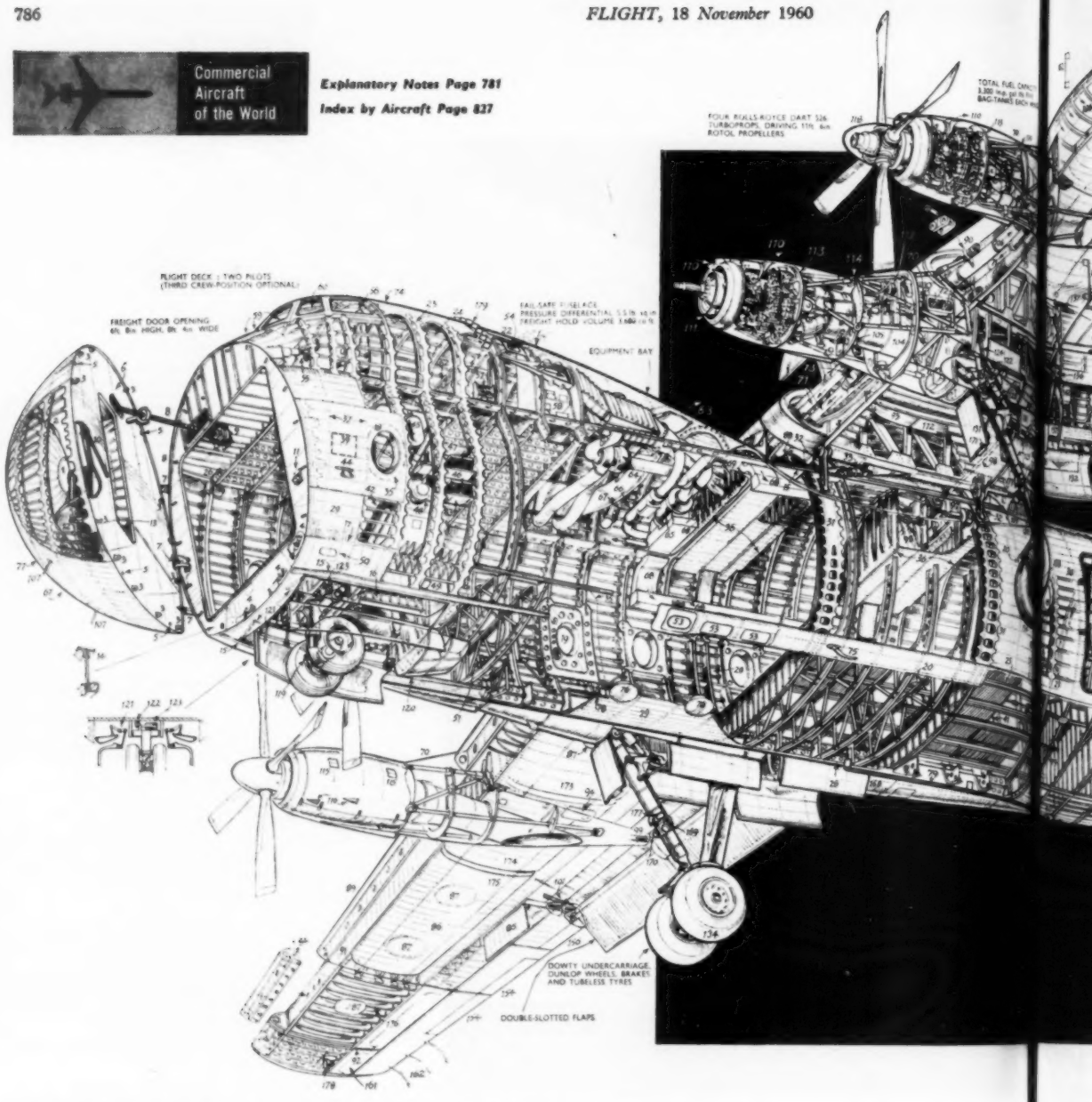

FOUR ROLLS-ROYCE DART 526 TURBOPROPS, DRIVING 11ft 6in ROTOL PROPELLERS
FLIGHT DECK (TWO PILOTS (THIRD CREW-POSITION OPTIONAL)
FREIGHT DOOR OPENING 6ft 8in HIGH, 8ft 4in WIDE
FAIL-SAFE FUSELAGE
EQUIPMENT BAY
DOWTY UNDERCARRIAGE, DUNLOP WHEELS, BRAKES AND TUBELESS TYRES
DOUBLE-SLOTTED FLAPS

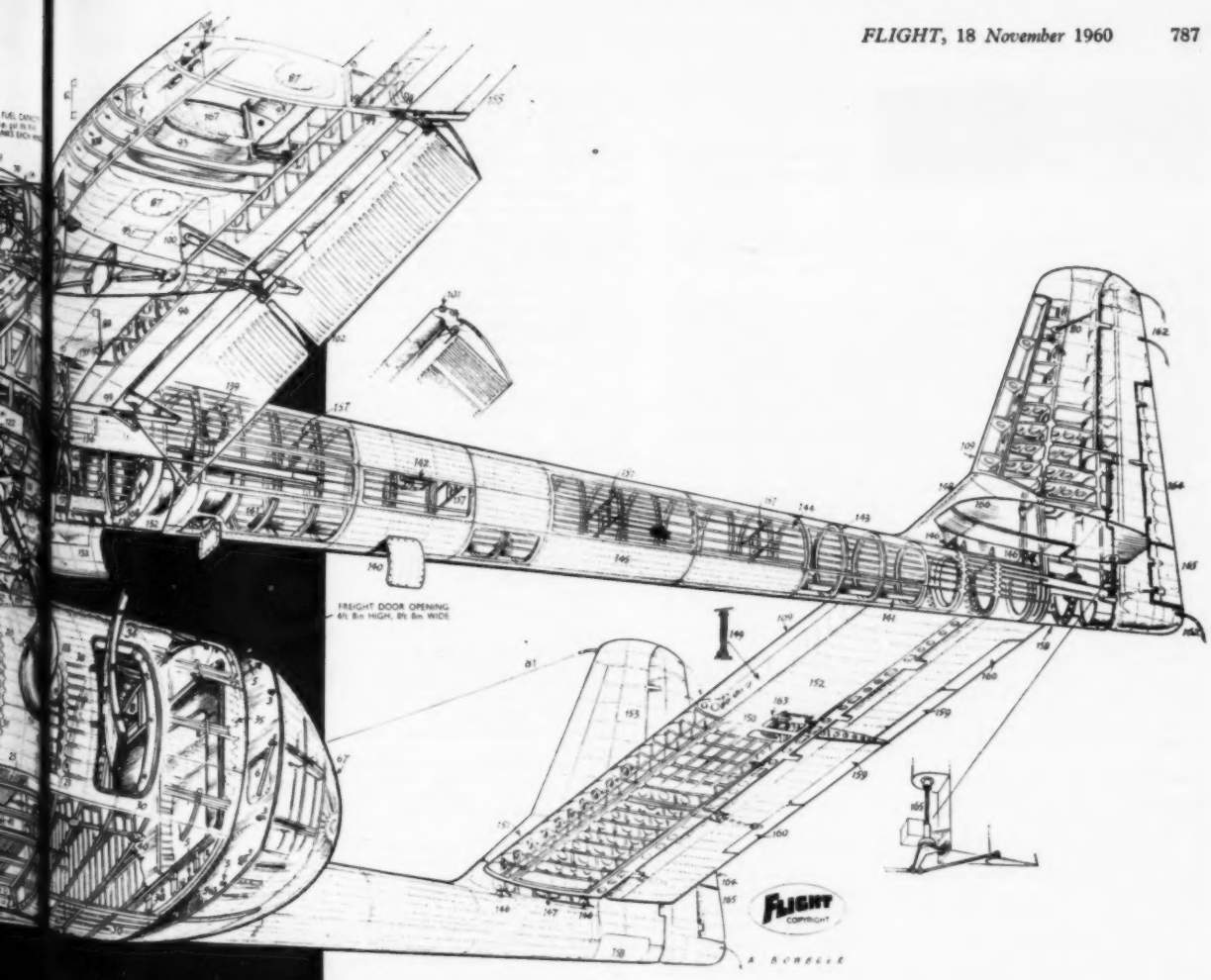
ARMSTRONG WHITWORTH AW.650 ARGOSY

Reference: page 782

Fuselage (structure)
1 Housing for Ekco E.160 radar scanner
2 Scanner hinge boxes
3 Door latching points
4 Fuselage jack assemblies for (3)
5 Pressure pads
6 Honeycomb-sandwich bulkheads
7 Three hinges, centre hinge bearing door weight
8 Door-operating screw-jacks
9 Two-speed gearbox and driving handle
10 Door-lifting "pole vault" lever, bungee-loaded
11 Receiving block for (10)
12 Crew-toilet and washroom floor
13 Baggage-compartment floor
14 Section of Frame 1 showing torsion box and door-sealing angle
15 Stainless-steel external longeron
16 Steel beams for nose undercarriage
17 Hard chine at floor level
18 Windows 18in x 13in
19 Emergency exit 36in x 20in
20 Emergency exit 26in x 19in
21 Emergency door
22 Crew-ditching exit
23 "Finger-plate" rip stoppers
24 Intercostal stringers with carry-through channel boom
25 Six longitudinal rails for freight-lashing or seating
26 Reduxed ends to flight-deck floor beams
27 Wall freight-lashing points
28 Skin 17 s.w.g.
29 Skin 19 s.w.g.
30 Skin 21 s.w.g.
31 Double frames to wing spar attachments
32 Swinging lift link
33 Swinging drag link
34 Passenger door
35 Reduxed doublers around cut-outs
36 Pressure bulkheads at spar cut-outs
37 Frames at 21in pitch
38 Fuselage drain gallery
39 Freight-door locking controls
40 Faired pads for Dowty hydraulic support struts (rear-loading case)
41 Bonded-sandwich floor panels
42 Folding ladder to flight deck
43 Cupboard for 46, 47 and 48

Fuselage (installed equipment)
44 Pitot head (port and starboard)
45 Oxygen bottle
46 Three 25 A-h Varley lightweight batteries
47 Control box
48 Ground air-conditioning connection
49 Oxygen charging points
50 Ground d.c. supply socket
51 Centralized dessicant pack
52 Piping to inter-pane airspace
53 Hydraulic service panels
54 Wing inspection light
55 Control columns
56 Captain's seat
57 Fuel-contents oscillator group
58 Converters, inverters, control panels
59 Nesa glass, electrically heated panels
60 Direct-vision panel
61 Hot-air demisting
62 Radio racks
63 Airflow through primary heat exchanger
64 Cold air unit
65 Secondary silencer
66 Recirculating fan
67 Air-discharge valves
68 Conditioned-air delivery duct
69 Recirculating air intake from lower deck
70 Godfrey Type 15 blowers (engines 1, 2 and 4)
71 Air from 70
72 Blower intakes and filters
73 Primary silencer

Aerials
74 VHF No 1
75 VHF No 2
76 Twin ADF loops
77 ILS glide-path
78 ILS marker



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79 ADF sense
80 VOR
81 HF

Wing structure and flaps
82 Front-spar section
83 Rear-spar section
84 Hinged leading edge
85 Hinged access panels
86 Wing skin 16 s.w.g.
87 Tank access panels
88 Fuselage-frame anchorage on spar neutral axis
89 Aerofoil NACA 23018 (modified) root, 23012 tip
90 Centre/intermediate wing joint
91 Intermediate/outer wing joint
92 Detachable tip
93 Tank-bay inner skin
94 Access to No. 3 tank fuel pumps
95 Fuel-water drain panels
96 Secondary structure, made by AWA (rest made by Avro)
97 Hydraulic flap motor, gearbox and transmission
98 Torque tubes
99 Flap attachment ribs
100 Endless chain
101 Roller and guide rail
102 Fluted skin
103 Centre-section flap removed

De-icing
104 Jet-pipe flap valve
105 Ram-air to heat exchanger
106 Warm air through leading edge
107 Ice detectors
108 Warm-air exhaust
109 Spraymat electric de-icing on empennage

Powerplants
110 Airflow through oil cooler
111 Engine air intake
112 Accessory gearbox above jet-pipe
113 Inter-zone firewall
114 Firewall (marking rear limit of Viscount-type power package)
115 Fire access panels
116 Cooling air to Zones 1 and 2
117 Cooling air to generator
118 Electrically heated spinner and intake

Undercarriage
119 Nose-undercarriage towbar attachment
120 Fixed fairing
121 Four interlinked doors
122 Retraction jack
123 Steering motor
124 Tubular support pyramid
125 Radius rod
126 Light-alloy main leg, breaking in centre
127 Breaker strut
128 Spring unit
129 Triple brake pipe
130 Maxaret unit
131 Fairing door and forward leg doors all linked to radius rod
132 Rear doors with sequenced hydraulic operation
133 Main-undercarriage lugs for rearwards towing bridle
134 Nylon ply tyres, 1.50 x 20

Booms
135 Top mounting on upper boom of rear spar
136 Bottom mounting with tubular bracing
137 Sub-longerons
138 Removable doors
139 Hydraulic header tank
140 Stress-bearing access hatch to 139
141 Catwalk, whole length of boom
142 Junction boxes
143 Light channel-section frames
144 Stringers lightly riveted over frames
145 Thick skin (14 s.w.g.)

Empennage
146 Tailplane attachment frames
147 Locating spigot
148 Non-structural fairing
149 Spar with two bonded webs
150 Bonded stringers
151 Detachable leading edges
152 Tailplane section NACA 0012
153 Fin section NACA 0014

Flying controls
154 Aileron spring tabs
155 Aileron trim/geared tab
156 Aileron geared tab
157 Fairlead for elevator and rudder cables
158 Access to rudder-cable tension regulators
159 Elevator trim tab
160 Elevator torsion-bar spring tab
161 Aileron horn-balance
162 Static dischargers
163 Elevator-cable tension regulator
164 Rudder trim/geared tab
165 Rudder torsion-bar spring tab
166 Elevator horn balance

Fuel system
167 Flexible fuel tanks between spars
168 Water/methanol tank, 68 Imp gal in each boom
169 Pressure fuelling/defuelling socket on each main-undercarriage radius rod
170 Pressure fuelling sockets for water/methanol system
171 Refuelling switch panels on aft face of fairing door
172 No 1 tank, 362 Imp gal
173 No 2 tank, 463 Imp gal
174 No 3 tank, 405 Imp gal
175 No 4 tank, 320 Imp gal
176 No 5 tank, 100 Imp gal

Additional equipment
177 Taxi/landing lights on main legs
178 Retractable landing light
179 Vortex generators

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Avro 758 A high-wing, rear-loading version of the 748, for freighting and supply dropping, the 758 (briefly reported in *Flight* for September 18, 1959) is a project only. The Indian Air Force is interested. A swing-tail version has also been examined.

Avro 771 Announced in September, the Avro 771 is a 45/60-seater "Viscount replacement"-type powered by two Bristol Siddeley BS.75 ducted-fans and intended for short-range regional networks. Faster than the contemporary BAC-107 project (cruise Mach number is 0.81) the wing loading, at 65lb/sq ft, is slightly higher but the Avro design will have leading-edge lift devices to reduce field length. First cost and operating costs should be less than those of the Viscount 810, i.e., basic price will, according to Avro in September last, be less than £½m.

Powerplant: Two Bristol Siddeley BS.75 turbofans of 7,350lb static thrust.

Dimensions: Span, 77ft 5½in; length, 80ft 4½in; height empty, 24ft 3in; wing area, 800 sq ft; sweepback at quarter chord, 30°.

Weights: Max take-off, 52,000lb; max landing, 50,200lb; zero fuel, 42,100lb; capacity payload, 12,000lb; weight less fuel and payload, 30,100lb.

Payload accommodation: Cabin volume (less flight deck), 2,460 cu ft; baggage and freight volume, 310 cu ft; cabin length, 44ft 4in; max internal width, 9ft 11in; headroom, 6ft 6in; max usable floor area, 413 sq ft; dimensions of largest door, 63in × 30in; max number of seats, 60 at 32in pitch.

Fuel capacity: 2,000 Imp gal (2,400 US gal).

Water capacity: 105 Imp gal (126 US gal).

Performance: Optimum-cost cruising speed, 486kt (560 m.p.h. at 25,000ft and 50,000lb); corres fuel consumption, 0.837lb/lb thrust/hr; balanced field length (max take-off weight, SL, ISA), 4,800ft; landing field length at 47,000lb, 4,500ft; range A (max payload), 1,214 n.m. (1,398 st.m.); range B (max fuel), 1,830 n.m. (2,110 st.m.); corres payload, 6,500lb; cruise Mach number, 0.81.

BAADE BB-152 See VEB.

BOEING *Boeing Airplane Company, Transport Division, Renton, Washington, USA.*

Boeing 307 Stratoliner First flown on December 31, 1938, the Stratoliner was a civil development of the B-17 bomber. Of the same generation as the DC-4, and a direct competitor, it went into service with Pan American and TWA in the early months of 1940. It was an airliner in advance of its time, being the first pressurized airliner to go into service, and although only ten were built, eight remain in service to this day: Cohata (1), Airnautic (1), Aigle Azur (5), and Air Vietnam (1).

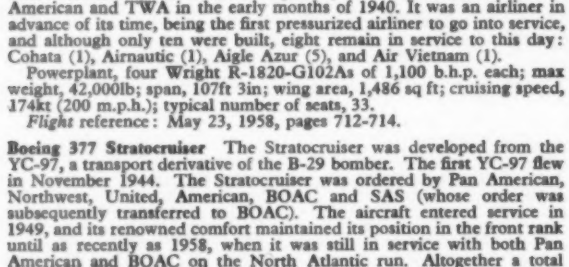
Powerplant, four Wright R-1820-G102As of 1,100 b.h.p. each; max weight, 42,000lb; span, 107ft 3in; wing area, 1,486 sq ft; cruising speed, 174kt (200 m.p.h.); typical number of seats, 33.

Flight reference: May 23, 1958, pages 712-714.

Boeing 377 Stratocruiser The Stratocruiser was developed from the YC-97, a transport derivative of the B-29 bomber. The first YC-97 flew in November 1944. The Stratocruiser was ordered by Pan American, Northwest, United, American, BOAC and SAS (whose order was subsequently transferred to BOAC). The aircraft entered service in 1949, and its renowned comfort maintained its position in the front rank until as recently as 1958, when it was still in service with both Pan American and BOAC on the North Atlantic run. Altogether a total of 56 were built, 21 of which are still owned by Northwest (6) and PanAm (15).

A total of 888 C-97 transports and KC-97 tankers were built for the US Air Force.

Avro 748 Series 1 (Rolls-Royce Dart RDa.6 turboprops)



Powerplant: Four Pratt & Whitney Wasp Major R-4360B-6 of 3,500 b.h.p. each driving 16½ft Hamilton Standard propellers.

Data appeared in *Flight* for November 20, 1959, page 582.

Boeing 707 The 707 family of Boeing jet airliners, which were developed as a private venture out of the company's unique jet bomber (B-47, B-52) experience, comprises six types of transport, listed below.

The prototype 707, the 367-80, which first flew in July 1954, led to a big USAF order for KC-135 jet tankers. More than 320 of these have been delivered against an order for a total of 426, contributing significantly to the commercial production programme.

The first 707 order came on October 13, 1955 from Pan American; the first 707-120 flew on December 20, 1957; and deliveries (to PanAm) began in September 1958 ahead of schedule. The 707 was introduced into regular service across the North Atlantic (by PanAm) on October 26, 1958. To date about 175 707s have been delivered to 18 operators (plus the USAF) and the order book stands at 254 for 21 operators, as follows:

707-120 American, 25 (to be modified to 120B standard); Continental, 5; Cubana, 2 (leased by Boeing to Western Air Lines); PanAm, 6; Qantas, 7 (to be modified to 120B standard); TWA, 15; USAF Military Air Transport Service, 3 (VC-137A).

707-120B American, 1; Qantas, 3.

707-220 Braniff, 5.

707-320 Air France, 17; PanAm, 26 (one leased to PIA); Sabena, 5; SAA, 3; TWA, 12.

707-420 Air-India, 4; BOAC, 15; El Al, 2; Lufthansa, 5; Varig, 2.

720 Aerlinte (Irish), 3; American, 10 (to be modified to 720B standard); Braniff, 3; Eastern, 15; United, 29.

720B American, 15; Avianca, 2; Ethiopian, 2; Lufthansa, 8; Western, 4.

Description in *Flight:* July 25, 1958, pages 144-147.

707-120 This is the JT3 domestic model. Basic price: about £1.68m.

Powerplant: Four Pratt & Whitney JT3C-6 turbojets of 11,200lb dry thrust each of 13,500lb with water injection.

Dimensions: Span, 130ft 10in; length, 144ft 6in; height empty, 42ft; wing area, 2,433 sq ft; sweep at quarter chord, 35°; aspect ratio, 7.07.

Weights: Max take-off, 247,000lb; landing, 175,000lb; zero fuel, 165,000lb; capacity payload, 43,000lb; weight less fuel and payload, 122,000lb.

Payload accommodation: Cabin volume, 8,294 cu ft; baggage and freight, 1,680 cu ft; cabin length, 104ft 10in; max width, 12ft 4in; max height, 14ft 2½in; max usable floor area, 1,092 sq ft; dimensions of largest door, 34in × 72in; max seats, 179.

Fuel capacity: Basic, 11,223 Imp gal (13,478 US gal).

Water capacity: 591 Imp gal (710 US gal).

Performance: Cont cruising speed, 495kt (570 m.p.h.) at 28,000ft and 180,000lb; balanced field length at max take-off weight, SL, ISA, 10,200ft; landing distance from 50ft at max landing weight, 6,000ft; range A (max payload), ISA (SR427 reserves), 2,720 n.m. (3,130 st.m.); range B (max fuel) (SR427 reserves), 3,750 n.m. (4,310 st.m.); corres payload, 20,500lb.

707-120B The 707-120B is distinguished by turbofan engines and the wing modifications applied to the 720, namely, three sections of leading edge flap and a false leading edge between inner pod and fuselage. Changes are also made to the main gear and cabin-air turbo-compressors. The result will be improved field performance, increased economy, and an increase in high-speed cruise of 18kt. These changes can be incorporated retrospectively, and American Airlines will convert their fleet of -120s in 1960-61 when the turbofans are ready for service.

Powerplant: Four Pratt & Whitney JT3D-1 turbofans of 17,000lb dry thrust at sea level, ISA + 31°F.

Dimensions: As 707-120.

Weights: Max take-off, 258,000lb; max landing, 185,000lb; zero fuel, 170,000lb; capacity payload, 47,000lb; weight less fuel and payload, 123,000lb.

Payload accommodation: As 707-120.

Fuel capacity: 14,487 Imp gal (17,398 US gal), plus 358 Imp gal (430 US gal) water.

Performance: Optimum-cost cruise, 484kt (557 m.p.h.) at 35,000ft and 200,000lb; corres consumption, 11,300lb/hr; balanced field length max weight, ISA, 8,700ft; (max landing weight), 6,200ft; range A (max payload), 3,725 n.m. (4,289 st.m.); range B (max fuel), 5,392 n.m. (6,209 st.m.); corres payload, 18,830lb; corres speed, 461kt (530 m.p.h.) at 37,500ft.

707-220 This is a shorter-body domestic version, powered by JT4s, ordered by one customer, Braniff. This operator wanted a higher reserve of power to meet the high-altitude, high-temperature conditions experienced on its Latin American routes.

Powerplant: Four P & W JT4A-3 turbojets of 15,800lb dry thrust each (no water injection).

Dimensions: As for the -120, except for length, 134ft 6in.

Weights: As for the -120, except for capacity payload, 34,000lb.

Payload accommodation: Approximately as for the -120.

Fuel capacity: As for the -120, but without water.

Performance: Cont cruise speed, approx as for -320; balanced field length, max take-off weight, SL, ISA, 6,900ft; landing distance from 50ft at max landing weight, 6,000ft; range A (max payload), 3,980 n.m. (4,580 st.m.); range B (max fuel), (SR427 reserve), 3,875 n.m.

707-320 Known as the Intercontinental, the -320 is the long-range model.

Powerplant: Four P & W JT4A-11 of 17,500lb thrust each (no water injection).

Dimensions: Span, 142ft 5in; length, 152ft 11in; height empty, 42ft 5½in; wing area, 2,892 sq ft; sweep at 0.25 chord, 35 deg.

Weights: Max take-off, 311,000lb; landing, 207,000lb; zero fuel, 190,000lb; capacity payload, 57,000lb.

(Continued on page 789)

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Payload accommodation: Cabin volume, 8,150 cu ft; baggage and freight volume, 1,785 cu ft; cabin length, 111ft 6in; max width, 12ft 4in; max height, 14ft 2½in; max usable floor area, 1,164 sq ft; dimensions of largest door, 34 × 72in; max seats, 189.

Fuel capacity: 19,831 Imp gal (23,815 US gal).

Performance: Cont cruising speed, 472kt (544 m.p.h.) at 35,000ft and 240,000lb; corres consumption, 13,900lb/hr; balanced field length (max weight, SL, ISA), 10,300ft; max landing weight, 7,300ft; range A (max payload), 4,042 n.m. (4,654 st.m.); range B (max fuel), 5,932 n.m. (6,831 st.m.); corres payload, 19,440lb.

707-420 This is the Rolls-Royce Conway-powered version, also known as the Intercontinental, as ordered by BOAC, Air India, Lufthansa and Varig. A cutaway drawing appears on pages 790-791.

Powerplant: Four Rolls-Royce Conway 508 (RCo.12) of 18,000lb thrust each (no water injection).

Dimensions: Span, 142ft 5in; length, 152ft 11in; height empty, 42ft 5½in; wing area, 2,892 sq ft.

Weights: Max take-off, 311,000lb; landing, 207,000lb; zero fuel, 190,000lb; capacity payload, 59,400lb; weight less fuel and payload, 130,600lb.

Payload accommodation: Cabin volume, 8,150 cu ft; baggage and freight volume, 1,785 cu ft; cabin length, 111ft 6in; max width, 12ft 4in; max height, 14ft 2½in; max usable floor area, 1,164 sq ft; dimensions of largest door, 34in × 72in; max seats, 189.

Fuel capacity: 19,831 Imp gal (23,815 US gal).

Performance: Cont cruise speed, 472kt (544 m.p.h.) at 35,000ft and 240,000lb; corres consumption, 13,500lb/hr; balanced field length, max weight, SL, ISA, 10,700ft; max landing weight, 7,300ft; range A (max payload), 4,339 n.m. (4,997 st.m.); range B (max fuel), 6,199 n.m. (7,139 st.m.); corres payload, 21,800lb.

720 (707-020) Higher-speed addition to the family, the 720 has the leading edge "glove" which extends the wing chord between fuselage and inner pod to increase Mach number from 0.88 to 0.90. In addition, "lift-booster" leading-edge flaps, three per side, will improve landing and take-off characteristics. (See also 707-120B.)

Powerplant: Four P & W JT3C-7 turbojets of 12,000lb dry thrust each (no water injection).

Dimensions: Span, 130ft 10in; length, 136ft 2in; height empty, 41ft 6½in; wing area, 2,433 sq ft.

Weights: Max take-off, 203,000lb; landing, 175,000lb; zero fuel, 142,000lb; capacity payload, 37,000lb; weight less fuel and payload, 105,000lb.

Payload accommodation: Cabin volume, 7,618 cu ft; baggage and freight volume, 1,390 cu ft; cabin length, 94ft; max width, 12ft 4in; max height, 14ft 2½in; max usable floor, 1,003 sq ft; max seats, 149.

Fuel capacity: 9,855 Imp gal (11,835 US gal).

Performance: Cont cruising speed, 484kt (557 m.p.h.) at 35,000ft and 160,000lb; corres consumption, 11,200lb/hr; balanced field length, max weight, SL, ISA, 6,700ft; max landing weight, 6,240ft; range A (max payload), 2,610 n.m. (3,006 st.m.); range B (max fuel), 3,600 n.m. (4,145 st.m.); corres payload, 19,300lb.

720B The improved airframe and aerodynamic features of the 720 are in this aircraft allied with the substantial performance advantages of the Pratt & Whitney JT3D-1 turbofan, rated at 17,000lb thrust (no water injection). Dimensions are the same as those of the 720, but additional wing bays are occupied by fuel. Deliveries are to start next year.

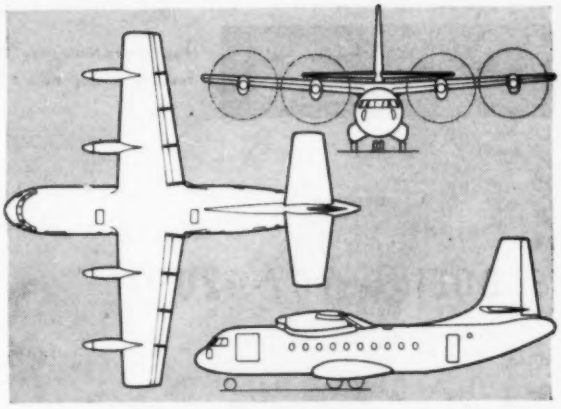
Weights: Max take-off, 229,000lb; landing, 175,000lb; zero-fuel, 149,000lb; capacity payload, 37,000lb; weight less fuel and payload, 112,000lb.

Fuel capacity: 12,315 Imp gal (14,790 US gal).

Performance: Cont cruising speed, 484kt (557 m.p.h.) at 35,000ft at 180,000lb; corres consumption, 10,600lb/hr; balanced field length, max weight, SL, ISA, 6,880ft; max landing weight, 6,240ft; range A (max payload), no reserves, 3,885 n.m. (4,474 st.m.); range B (max fuel) no reserve, 5,040 n.m. (5,802 st.m.); corres payload, 19,300lb.

727 During the past three years this projected short-haul jet airliner has passed through a number of evolutionary stages. The design has now more or less crystallized, and at the Boeing board meeting next month a decision is likely to be taken either to release drawings to the shops or to abandon the project. The 727 fuselage is slightly shorter than that of the 707's, but it has the same cross-section. Three engines are mounted at the rear, and the entirely new wing employs leading-edge flaps and blown trailing-edge flaps, and is designed to attain a maximum lift coefficient of 2.5. Although this complicated wing will increase the price it is deemed an essential stepping-stone to the achievement of a balanced field length of 4,500ft, which is said to be demanded by US operators who would like to use the 727 as a local-service vehicle from hot and high airfields. Although from the performance viewpoint the best engine appears to be the Allison AR.963 (Rolls-Royce RB.163 produced at Indianapolis), Boeing have for the American market selected the Pratt & Whitney JT8D-1, rated at about 10,000lb dry and of slightly larger diameter. Gross weight will be in the 135,000/140,000 bracket, and up to 90 passengers will be accommodated with six-abreast seating.

Owing to the fact that some of the 727 tooling will be the same as that for the 707 it is hoped to fix the price at not more than $4m (£1.43m). Production deliveries are being quoted for the first quarter of 1964. Boeing need at least 100 firm sales for the project to go ahead, but Eastern and United are reported already to have signed conditional letters of intent for 40 aircraft each.



Breguet 942 general arrangement (Turboméca Turmo IIID turboprops)

BOULTON PAUL *Boulton Paul Aircraft Ltd, Fordhouses, Wolverhampton, Staffordshire, England.*

P146 Investigations by the company into VTOL configurations on behalf of the Ministry of Aviation have led them to a 96-seat VTOL airline project incorporating 18 Rolls-Royce RB.153 lifting engines installed in pods of five at the extremities of the main swept wings and the canard noseplane. Forward propulsion is provided by three Rolls-Royce RB.163s installed aft.

BREGUET *Société Anonyme des Ateliers d'Aviation Louis Breguet, 24, Rue Georges Bizet, Paris 16e, France.*

Breguet 763 Deux Ponts The Breguet 763 stems from the earlier Type 761, the design of which was started in 1944 and which flew for the first time on February 15, 1949. The Deux Ponts fuselage is the same as that of the 761 but the span is increased and the wings reinforced; twelve 763s were ordered by Air France in 1951 (it is operated by the French airline under the name Provence) and the prototype flew for the first time on July 20, 1951. The Service version, the Type 763, is known as the Sahara, and 15 of these were ordered in 1956.

Powerplant: Two Pratt & Whitney R-2800-CA18s driving Hamilton Standard propellers.

Data appeared in *Flight* for November 20, 1959, page 583.

Breguet 940 Integral A STOL research machine built to French Government contract, the Integral first flew on May 21, 1958. Its trials have substantiated Breguet's belief that good cruising speed and carrying capacity are aerodynamically reconcilable with STOL capabilities without helicopter propulsion. The basic concept is the "vectored slipstream": four big interconnected propellers blow across the whole span of a normally loaded wing which is generously endowed with full-span double-slotted flaps. Powerplant consists of four Turboméca Turmo II turboprops of 400 h.p. each. Loaded weight is 16,000lb.

Flight reference: May 30, 1958.

Breguet 941 and 942 These two aircraft differ only in their fuselages, the 941 being unpressurized, the 942 having a circular-section pressurized fuselage. The military 941 is being built to Government contract, and is due to fly in April 1961, powered by four Turboméca Turmo IIID turboprops. Originally it was planned to install four de Havilland (General Electric T58 licence) Gnome turboprops of 1,250 s.h.p.: this installation is now offered as an alternative for both the 941 and 942. Consumption of the two engines is said by the manufacturer to be equivalent, so that performance figures are the same for both the 941 and 942. The Gnome installation, being lighter, allows a payload bonus of 450lb.

The 941 and 942 are of course developed from the 940 research vehicle, benefiting from all the successful flight testing so far achieved, and they fill a unique requirement for very-short-field (800-1,500ft) performance—allowing, for the first time, a fixed-wing vehicle with relatively low operating cost to compete with the helicopter in the city centre - city centre air transport business.

Basic price: Quoted by an unofficial American source at about £250,000 for the 941.

The following data apply to the commercial Breguet 942:—

Powerplant: Four Turboméca Turmo IIID turboprops of 1,250 s.h.p. each driving Breguet Ratier 14ft 9in reversing propellers.

Dimensions: Span, 76ft 1in; length, 76ft 9½in; height, 31ft 8in; wing area, 887 sq ft.

Weights: Max take-off, 44,000lb; max payload, 12,350lb (13,900lb for the 941 freighter version); max landing weight, 40,000lb; zero fuel weight, 39,300lb; weight less fuel and payload, 26,950lb.

Payload accommodation: Cabin volume, 2,100 cu ft; baggage and freight volume, 350 cu ft; cabin length, 30ft 8in; max internal width, 9ft 7in; max height, 6ft 6in; max usable floor area, 286 sq ft; dimensions of largest door, 59in × 71in; max number of seats, 50 five-abreast at 35in pitch.

Fuel capacity: 1,610 Imp gal (1,940 US gal).

(*Continued on page 792*)

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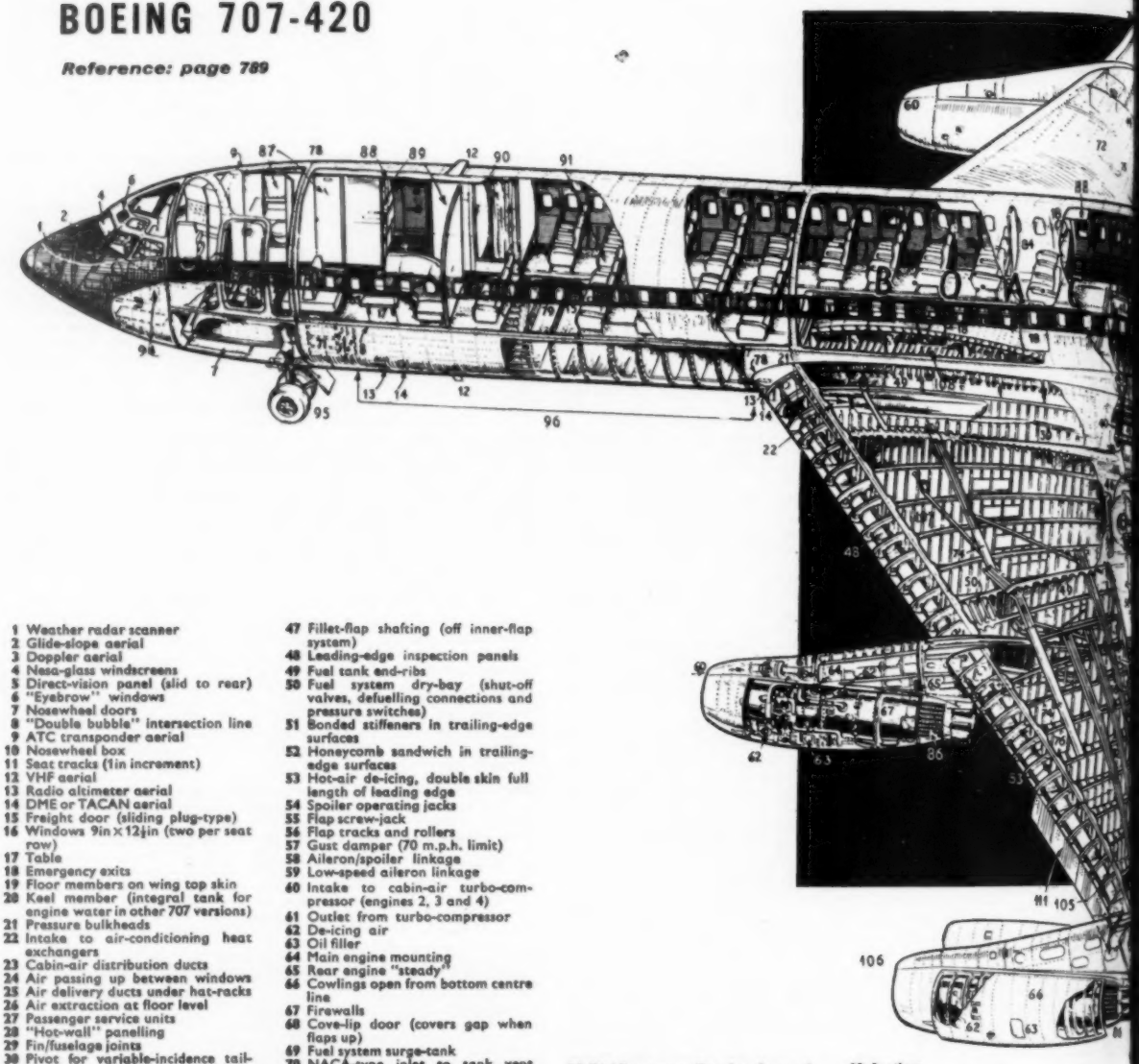
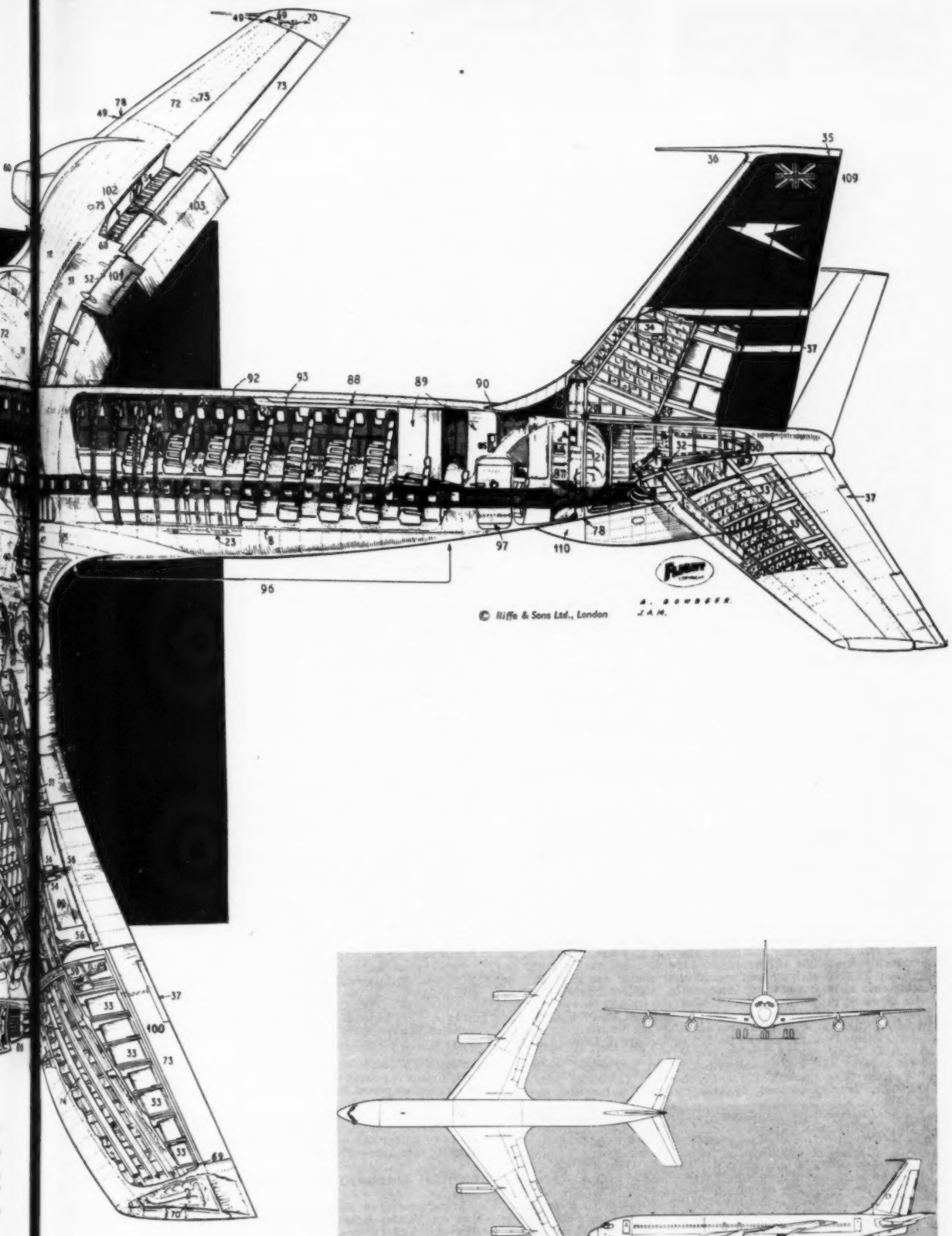
BOEING 707-420

Reference: page 789



1 Weather radar scanner
2 Glide-slope aerial
3 Doppler aerial
4 Nesa-glass windscreens
5 Direct-vision panel (slid to rear)
6 "Eyebrow" windows
7 Nosewheel doors
8 "Double bubble" intersection line
9 ATC transponder aerial
10 Nosewheel box
11 Seat tracks (1in increment)
12 VHF aerial
13 Radio altimeter aerial
14 DME or TACAN aerial
15 Freight door (sliding plug-type)
16 Windows 9in × 12½in (two per seat row)
17 Table
18 Emergency exits
19 Floor members on wing top skin
20 Keel member (integral tank for engine water in other 707 versions)
21 Pressure bulkheads
22 Intake to air-conditioning heat exchangers
23 Cabin-air distribution ducts
24 Air passing up between windows
25 Air delivery ducts under hat-racks
26 Air extraction at floor level
27 Passenger service units
28 "Hot-wall" panelling
29 Fin/fuselage joints
30 Pivot for variable-incidence tailplane
31 Tailplane screw jack
32 Tailplane centre-section joints
33 Control-surface balance panels
34 VOR aerial
35 Loran aerial
36 HF aerial
37 Control tabs
38 Leg trunnion at end of forged rib
39 "Beaver tail" members top and bottom
40 Undercarriage retraction jack in walking-beam
41 Radius rod
42 Radius rod cracker-jack
43 Undercarriage drag-member
44 Doors on main leg
45 Double-folding mainwheel doors
46 Fuel dump chute (retracted)
47 Fillet-flap shafting (off inner-flap system)
48 Leading-edge inspection panels
49 Fuel tank end-ribs
50 Fuel system dry-bay (shut-off valves, defuelling connections and pressure switches)
51 Bonded stiffeners in trailing-edge surfaces
52 Honeycomb sandwich in trailing-edge surfaces
53 Hot-air de-icing, double skin full length of leading edge
54 Spoiler operating jacks
55 Flap screw-jack
56 Flap tracks and rollers
57 Gust damper (70 m.p.h. limit)
58 Aileron/spoiler linkage
59 Low-speed aileron linkage
60 Intake to cabin-air turbo-compressor (engines 2, 3 and 4)
61 Outlet from turbo-compressor
62 De-icing air
63 Oil filler
64 Main engine mounting
65 Rear engine "steady"
66 Cowlings open from bottom centre line
67 Firewalls
68 Cove-lip door (covers gap when flaps up)
69 Fuel system surge-tank
70 NACA-type inlet to tank vent system
71 Electrical racks (forced aircooled)
72 Two (independent) boost pumps in each main tank
73 Honeycomb-sandwich aileron skins
74 Surge chambers
75 Gravity fuel fillers
76 Pressure-refuelling dry bay
77 Cabin attendants' seats
78 Production break-lines
79 Wide-angle lens for freight hold inspection
80 Tank access doors
81 Spring tab (full surface movement available for ground test)
82 Tank vent system formed by wing stringers
83 Eight-seat lounge
84 Dividing screen (1st class forward, tourist aft)
85 Drinking fountain
86 Noise suppressors and thrust reversers
87 Toilets
88 Dinghy stowage
89 Galley
90 Coat space
91 First-class five-abreast seating
92 Second-class six-abreast seating
93 Window between each frame
94 Flight deck: captain, first officer, engineer, navigator
95 Forward-retracting nose gear
96 Underfloor freight hold
97 Outward-opening plug-type doors
98 Inward-retracting bogie undercarriage, multi-disc brakes
99 Spoilers
100 Low-speed ailerons
101 High-speed ailerons
102 Spoilers shown open
103 Double-slotted flaps
104 Outer (reserve) fuel tank 361 Imp gal each side
105 Outer integral fuel tank 1,946 Imp gal each side
106 Rolls-Royce Conway 508 engines
107 Inner integral fuel tank 3,305 Imp gal each side
108 Centre-section fuel tank 6,429 Imp gal
109 36in fin-tip extension
110 Ventral fin
111 Leading-edge flap lowered (port and starboard)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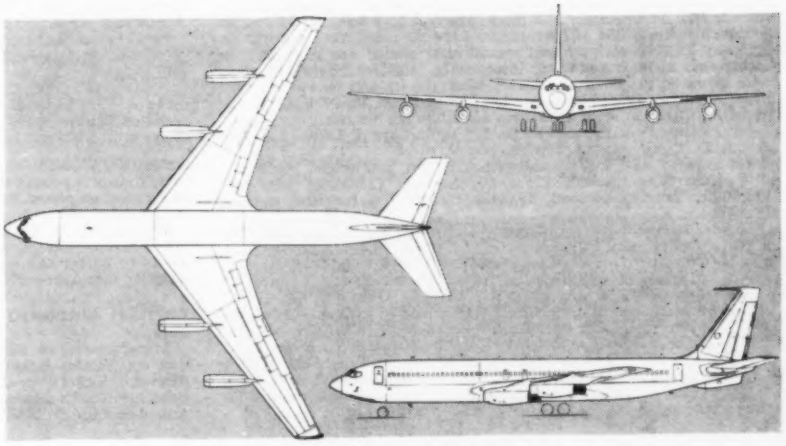

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Bristol Britannia 312 of BOAC (Bristol Siddeley Proteus 765 turboprops)

Performance: Opt cost cruising speed at 1,500ft and 40,000lb, 216kt (248 m.p.h.); corres specific fuel consumption, 0.11; take-off distance to clear 35ft, ISA, SL (one engine failure, grass surface, max take-off weight), 1,440ft; typical take-off run, concrete surface, max take-off weight, 625ft; CAR landing field length (ISA, SL, concrete surface, 1.6 factor, max landing weight), 1,345ft; typical landing run, concrete surface, max landing weight, 395ft; range A (max payload), 750 n.m. (860 st. m.); range B (max fuel), 1,420 n.m. (1,630 st.m.); corres range B payload, 4,000lb.

Breguet 945 A smaller version of the Breguet 942 is under study for operation from 1,000ft hot and high-altitude airstrips. Designated Breguet 945, it would weigh about 20,000lb and be powered by two Turboméca Turmo IIIDs. Payload would be about 3,300lb and could be carried for more than 900 miles at almost 240 m.p.h.

BRISTOL *Bristol Aircraft Ltd, Filton House, Bristol, England (Member of the British Aircraft Corporation).*

Bristol 170 Freighter The prototype Bristol Freighter first flew on December 2, 1945, and was originally offered in two main versions; the Freighter with nose loading doors, and the Wayfarer all-passenger version without nose doors. Initial 170s had a span of 98ft and square tips, but the Freighter Mks 21, 21A and 21E and Wayfarer 22A of 1948 had a 10ft increase in span and a max weight of 40,000lb; the engines were two 1,700 b.h.p. Bristol Hercules 672s. The Freighter 31 and 31E have increased power (Bristol Hercules 734 of 2,050 h.p.) and take-off weight (44,000lb), together with a dorsal fin, while the Mk 32, designed for Silver City, has a 5ft 4in longer nose to accommodate three small cars instead of two. A total of 214 Bristol 170s were built for both civil and military operators; 64 are in airline service with 18 carriers.

Mk 21 All-freight version with flight deck only soundproofed. **Mk 21A** "Mixed" version, 16-20 passengers and freight. **Mk 21E** "Mixed" version with movable bulkhead. Entire cabin soundproofed. **Mk 22A** Passenger version seating 32-36. No nose doors. **Mk 31** As Mk 21. **Mk 31E** As Mk 21E. **Mk 32** With accommodation for 2-3 cars and up to 23 passengers.

Bristol Freighter Mks 31 and 32

Powerplant: Two Bristol Hercules 734 piston engines of 2,050 h.p. each driving D.H. 14ft propellers.

Dimensions: Span, 108ft; length, 68ft 4in (Mk 31), 73ft 8in (Mk 32); height empty, 24ft; wing area, 1,487 sq ft.

Weights: Max take-off, 44,000lb; landing, 44,000lb; capacity payload, 14,400lb (Mk 31), 12,000lb (Mk 32); weight less fuel and payload, 28,084lb (Mk 31), 30,553lb (Mk 32).

Payload accommodation: Cabin volume, 2,360 cu ft (Mk 31), 2,900 cu ft (Mk 32); cabin length, 49ft (Mk 31), 57ft 2in (Mk 32); max width, 8ft; max height, 6ft 7½in; nose door, 6ft 8½in × 6ft 7½in.

Fuel capacity: 1,172 Imp gal.

Performance: Cont cruise speed, 166kt (191 m.p.h.) at 10,000ft at 44,000lb; corres fuel consumption, 1.3 st.m.p.g.; balanced field length, max take-off weight, SL, ISA, 3,700ft; SL, ISA+15°C, 4,100ft; 5,000ft, ISA, 4,800ft; landing distance from 50ft, 2,280ft; range A (max payload), 695 n.m. (800 st.m.); range B (max fuel), 1,610 n.m. (1,850 st.m.); corres payload, 5,000lb; corres speed, 143kt.

Britannia 100 First of the Britannia family of big turboprop airliners, powered by Proteus 705 turboprops and seating up to 92 passengers, the 100 was produced exclusively for BOAC. The prototype 100, G-ALBO, first flew on August 16, 1952. Fifteen, designated 102, were built for the Corporation from 1954-56, production being subsequently concentrated on the larger and more powerful 250/300/310/320 series described below. The 102 inaugurated the first Britannia services on February 1, 1957, and a *Flight* special issue of that date described the background to its introduction into service. Further *Flight* references were given on p 129 of that issue; other articles will be found in the issues of July 6, 1956; November 1, 1957; and July 25, 1958. Price paid by BOAC (fixed in April 1955) was £768,000 per aircraft.

Powerplant: Four Bristol Proteus 705 turboprops of 3,900 e.h.p. each driving D.H. four-bladed, 16ft propellers.

Dimensions: As for 320, except length, 114ft, and height, 36ft 8in.

Weights: Max take-off, 155,000lb; landing, 125,000lb; zero fuel, 113,000lb; capacity payload, 25,000lb; weight less fuel and payload, 88,000lb.

Payload accommodation: Cabin volume, 5,150 cu ft; baggage and freight volume, 750 cu ft; cabin length (incl pantry and lavatory), 76ft; max width, 11ft 7in; max height, 6ft 8in; max usable floor area, 810 sq ft; dimensions of largest doors, 70in × 31.5in.

Fuel capacity: 6,690 Imp gal (8,034 US gal).

Performance: Cont cruising speed, 315kt (362 m.p.h.) at 20,250ft and 135,000lb; corres specific fuel consumption, 0.647lb/b.h.p./hr; balanced field length at max take-off weight, SL, ISA, 6,320ft; at SL, ISA+15°C, 7,350ft; at 5,000ft, ISA, 8,020ft; landing distance from 50ft, 5,200ft; range A (max payload), 2,945 n.m. (3,385 st.m.); range B (max fuel), optimum cruise, 3,690 n.m. (4,250 st.m.); corres payload, 13,480lb; corres cruising speed, 285kt (328 m.p.h.).

Britannia 250 This is the generic type-designation of the military version of the Britannia, 23 of which are being delivered to RAF Transport Command by Bristol, and by Short Brothers & Harland from the assembly line operated at Belfast since December 1953.

Britannia 252 This is a passenger-cargo version, three of which were originally ordered for Government trooping work by the Ministry for operation by British independent airlines. In the spring of 1959, as a result of a change in policy, these aircraft were transferred to RAF Transport Command. Maximum payload is 28,000lb, including 84 passengers and freight which is accommodated on the forward strengthened portion of the floor, and loaded via an enlarged door.

Powerplant: As for 320.

Britannia 253 This is essentially an all-cargo transport, built entirely to military requirements. Twenty are being delivered to RAF Transport Command. A special feature is the heavy "floating" floor designed by Shorts (*Flight*, August 9, 1957). The forward freight door has the same dimensions as that of the 252. Max payload is 34,000lb.

Powerplant: As for 320, except that the military designation of the Proteus 765 with water injection is 255.

Weights and performance data: page 586 of *Flight*, November 20, 1959.

Britannia 300 Three of these were built, one for the Ministry and two, designated 302, which were bought by Aeronaves de Mexico. The 300 has the capacity and power of the 305, but less tankage—6,690 Imp gal instead of 8,580 Imp gal and a max take-off weight of 170,000lb.

Britannia 305 A total of five of this model were built; two are in service with British United Airways (**307**), two with Transcontinental (**308**), and one with Ghana Airways (**309**). They are in all major respects comparable with the 310 model, the designation 305 being applied when, in 300 form, they were modified to bring them as closely as possible to 310 standard, including in particular the addition of the 310 wing with 8,580 Imp gal.

Britannia 310 This is the standard long-range version as operated by BOAC (17 312s); El Al (four 313s); CPAL (six 314s and two 320s); British United Airways (two 317s); Cubana (three 318s); Cunard Eagle (one 318); Ghana Airways (one 310).

The 310, first of which was flown on December 31, 1956, entered service across the North Atlantic with BOAC on December 19, 1958.

All data as for 320, except: capacity payload, 34,900lb; weight less fuel and payload, 93,100lb, and range B payload, 23,500lb.

Britannia 320 This was the standard production commercial Britannia until production ceased in 1959. It is a development of the 310 incorporating numerous detail engineering improvements. Of six built, two have been bought by Canadian Pacific Airlines. Two of Cubana's 318s are 320-standard, as also are one BOAC 312 and one El Al 313. Basic price new was £1.07m. *Flight* description, July 25, 1958.

Powerplant: Four Bristol Proteus 765 turboprop engines of 4,450 e.h.p. driving de Havilland Hydromatic four-blade 16ft propellers.

Dimensions: Span, 142ft 3.5in; length, 124ft 3in; height empty, 37ft 6in; wing area, 2,075 sq ft; aspect ratio, 9.76.

Weights: Max take-off, 185,000lb; landing, 137,000lb; zero fuel, 128,000lb; capacity payload (ZFW-limited), 34,369lb; weight less fuel and payload, 93,631lb.

Payload accommodation: Cabin volume, 5,877 cu ft; baggage and freight volume, 910 cu ft; cabin length, 86ft 3in; max width, 11ft 7in; max height, 6ft 8in; max usable floor area, 883 sq ft; dimensions of largest door(s), 70in × 31.5in; max seats, 149.

Fuel capacity: 8,580 Imp gal (10,300 US gal).

Performance: Cont cruising speed, 345kt (385 m.p.h.) at 22,000ft and 150,000lb; corres specific fuel consumption, 0.585lb/b.h.p./hr; balanced field length at max take-off weight, SL, ISA, 8,150ft; at SL, ISA+15°C, 9,600ft; at 5,000ft ISA, 11,800ft; landing distance from 50ft; 6,000ft; range A (max payload), 3,620 n.m. (4,160 st.m.); range B (max fuel), optimum cruise, 4,530 n.m. (5,000 st.m.); corres payload, 23,000lb; corres cruise speed, 310kt (357 m.p.h.).

Bristol 198 This is the project number reportedly given to the supersonic transport project which may form the basis of the £350,000 design study contract placed with the British Aircraft Corporation by the MoA in October 1960.

It is unofficially described as a light-alloy Mach 2.2 transport seating 100/120 passengers, and capable of a 3,500 n.m. stage length. Geometry would be ogival narrow-delta, and one possible powerplant six Bristol Siddeley Olympus with reheat.

BRITISH AIRCRAFT CORPORATION *100 Pall Mall, London SW1.*

Manufacturers of commercial aircraft in the British Aircraft Corporation are Vickers-Armstrongs (Aircraft), Bristol Aircraft and Hunting Aircraft. Vickers' products appear under the heading Vickers, and Bristol Aircraft's products appear under Bristol. Hunting Aircraft are responsible for the BAC-107, which is described on the next page.

BAC-107 Based on the H-107 project first drafted early in 1958 by Hunting Aircraft, the BAC-107 is a short-range jet transport in the Viscount replacement category. It was revived when Hunting joined the British Aircraft Corporation in 1960, and it is being vigorously promoted as a smaller partner for BAC's VC11. Numerous changes were made as a result of Vickers' influence. One external change is the elevation of the tailplane to the top of the fin, and there are more cabin windows (26 per side). The powerplant comprises two BS.75s of 7,350lb thrust each, conferring the economy that is a dominating design requirement; it is said that the 107 uses fewer gallons per mile than the Viscount that it is intended to replace. Maximum seating in a Viscount-width fuselage is 59, and cruising speed is in the 500 m.p.h. bracket. Field length is 5,000ft. The BAC 107 becomes the smallest member of the Vickers family of rear-engined jet transports, the others being the VC11 project, the VC10 and the Super VC10. It could be ready for service in 1964/1965.

Flight references: November 20, 1959, page 609; September 2, 1960, page 341; September 16, 1960. Operator's drawing, page 812. Basic price: "less than £500,000."

Powerplant: Two Bristol Siddeley BS.75 of 7,350lb static thrust each.

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Dimensions: Span, 81ft 8in; length, 84ft; height, 23ft; wing area, 825 sq ft; sweepback (¼ chord), 20°.

Weights: Max take-off, 48,500lb; max landing, 46,000lb; zero fuel weight, 41,000lb; capacity payload, 12,000lb.

Payload accommodation: Cabin length, 48ft 8in; max internal width, 10ft; cabin height, 6ft 5in; seating, 50 first-class 36in pitch four abreast, 59 economy class.

Fuel capacity: 2,230 Imp gal.

Performance: Typical cruising speed, 440kt (Mach 0.75); approach speed (flap blowing is not fitted), 110kt; max-payload range with "realistic" reserves, 435 n.m. (500 st. m.)

CANADAIR *Canadair Ltd, Post Office Box 6087, Montreal, Canada.*

DC-4M A pressurized, Merlin-engine development of the Douglas DC-4/C-54, the DC-4M was named North Star by TCA, who first operated it in 1947 and who still own 21. The DC-4M was bought also by BOAC in March 1949; they named it Argonaut, and three remain in Corporation service. Other operators are EAAC, 3 (ex-BOAC), and Overseas Aviation, 6 (ex-BOAC) and Flying Enterprise, 3 (ex-BOAC).

The DC-4M was described in *Flight* on June 26, 1947.

Powerplant: Four Rolls-Royce Merlin Mk 626 of 1,760 b.h.p. driving Hamilton Standard 13ft 1in propellers.

Dimensions: Span, 117ft 6in; length, 93ft 7½in; height, 27ft 6in; wing area, 1,457 sq ft.

Weights: Max take-off, 82,300lb; landing, 70,000lb; zero fuel, 66,000lb; capacity payload, 17,156lb; weight less fuel and payload, 46,728lb.

Payload accommodation: Max seats, 55; baggage and freight volume, 698 cu ft.

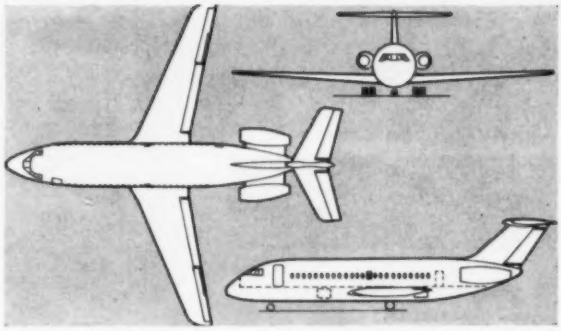
Fuel capacity: 3,226 Imp gal (3,870 US gal).

Performance: Cont. cruising speed 286kt (329 m.p.h.) at 10,000ft and 70,000lb; range A (max payload), 2,075 n.m. (2,385 st.m.); range B (max fuel), 3,240 n.m. (3,730 st.m.).

CL-44D-4 To fly at Montreal this month is the first CL-44D-4, a design which promises outstanding economy and flexibility as a large cargo transport or convertible cargo/passenger carrier. Based on the Bristol Britannia and its Canadair CL-28 maritime reconnaissance derivative, the Rolls-Royce Tyne-powered CL-44 has an exceptional payload-range capacity and should have a lower operating cost per ton-mile than any other aircraft on order by the airlines; Canadair claim 40 per cent better than the best cargo aircraft now operating.

The present version, announced in 1959, has a swinging tail section for direct aft loading. The fuselage will now accept a single unit 84ft long, 11ft wide and 6¾ft high, and weighing 65,200lb. It is this version, the CL-44D-4, for which Seaboard & Western and Flying Tiger respectively placed orders in May 1959 for five aircraft (with an option on five) and ten aircraft for delivery and service in 1961. Slick Airways confirmed an order for two Forty-fours in May 1960. The RCAF have ordered a further 12 of the military side-loading version, the CC-106.

Looking ahead, by taking advantage of Tyne power increases the basic CL-44 should eventually carry payloads of up to 100,000lb, grossing around 230,000lb.



Provisional general arrangement of the BAC-107 (two BS.75 turbofans)

Flight references: December 12, 1958; cutaway drawing, November 20, 1959. Price with spares: about £1.6m.

Powerplant: Four Rolls-Royce Tyne 12 Mk 515 of 5,730 e.h.p. driving de Havilland 16ft 4Bl propellers.

Dimensions: Span, 142ft 3.6in; length, 136ft 10in; height, 38ft 7in; wing area, 2,075 sq ft.

Weights: Max take-off, 205,000lb; landing, 165,000lb; zero fuel, 155,000lb; capacity payload (cargo), 66,480lb, (passenger), 37,630lb; weight less fuel and payload (cargo), 88,520lb (passenger), 105,700lb.

Payload accommodation: Cabin volume (less flight deck), 6,239 cu ft; baggage and freight volume, 1,109 cu ft; cabin length, 98ft 1in; max width, 11ft 5in; max height, 6ft 9in; max usable floor area (less flight deck), 1,080 sq ft; max number of seats, 189 at 28-30in pitch.

Fuel capacity: 10,150 Imp gal (12,190 US gal).

Performance: Typical cruising speed 342kt (394 m.p.h.) at 20,000ft and 165,000lb weight; corres s.f.c. 0.043lb/hr/e.s.h.p.; balanced field length at max take-off weight, SL, ISA, 7,660ft; landing distance from 50ft, 6,780ft; range A (max payload), 3,110 n.m. (3,570 st.m.) (cargo), 4,300 n.m. (4,950 st.m.) (pass.); range B (max fuel), 5,500 n.m. (6,540 st.m.); cruise, Mach 0.62; V_{NE}, 278kt EAS; V_{NO}, 250kt EAS (275kt at 138,000 ZFW); V_{SO}, 95kt EAS.

Canadair 540 This is the new production 540, built by Canadair at Montreal on Convair jigs, powered by Napier Elands. By increasing internal cabin length, standard accommodation for 48 first-class seats instead of 44 is available, and engineering improvements include better braking, increased fuel capacity and faster undercarriage retraction. Recent developments are a 64-seater with 32in pitch non-reclining seats. Two 52-seater Canadair 540s were sold to Quebecair in August fitted with an APU in the tail. This provides DC current and a 74° F cabin temperature irrespective of OAT. See also Convair 540.

Ten Canadair 540s are in production for the RCAF, designated CC-109(CL-66B). Delivery to the RCAF is due to be completed this autumn. Basic price £436,000.

Powerplant: Two Napier Eland 504A turboprops each producing 3,500 e.h.p. for take-off (at SL, ISA) and driving de Havilland 4Bl four-blade, 13ft 6in diameter propellers.

Dimensions: Span, 105ft 4in; length, 79ft 2in (with radome, 81ft 6in); height, 28ft 2in; wing area, 920 sq ft.

Weights: Max take-off, 53,200lb; landing, 50,670lb; zero fuel, 47,000lb; capacity payload, 12,986lb; max space payload, 11,900lb; weight less fuel and payload, 34,014lb.

Payload accommodation: Cabin volume (less flight deck), 2,515 cu ft; baggage and freight volume, 402 cu ft; cabin length, 54ft 10in; max width, 8ft 11in; max height, 6ft 7in; max usable floor area (less flight deck), 396 sq ft; dimensions of largest doors, 36in × 83in; max seats, 70 at 30in pitch.

Fuel capacity: 1,690 Imp gal (2,032 US gal, or 2,580 US gal with optional bag tanks).

Performance: Typical cruising speed, 279kt (321 m.p.h.) at 20,000ft and 46,000lb; balanced field length, max take-off weight, SL, ISA, 4,550ft; landing distance from 50ft, 4,020ft; range A (max payload), 785 n.m. (905 st.m.); range B (max fuel), 1,800 n.m. (2,070 st.m.) at 279kt (322 m.p.h.) with 5,572lb payload; V_{NE}, 293kt EAS; V_{NO}, 260kt EAS; V_{SO}, 77kt EAS.

CASA *Construcciones Aeronauticas, SA, Calle del Rey Francisco, Madrid.*

CASA-207 Azor A replacement for the DC-3, and possibly also for Bristol Freighters and Languedocs in service with Iberia and Aviacion y Comercio, the prototype Azor first flew in September 1955. Airline

Casa Azor (two Bristol Hercules 730 piston engines)

Allison Convair 340/440 (Allison 501-D13 turboprops)

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orders have not so far been forthcoming, although the project is still active. Suggestions were at one time made that the Azor might be re-engined with Napier Eland turboprops as the **209**.

Powerplant: Two Bristol Hercules 730s of 2,040 b.h.p. each, driving D.H. 12ft 9in propellers.

Dimensions: Span, 91ft 2in; length, 68ft 5in; height, 25ft 5in; wing area, 924 sq ft.

Weights: Max take-off, 37,480lb; landing, 33,960lb; zero fuel, 31,500lb; capacity payload, 9,000lb; weight less fuel and payload, 23,670lb.

Payload accommodation: Cabin volume (less flight deck), 1,630 cu ft; baggage and freight volume, 285 cu ft; cabin length, 37ft 11in; max width, 7ft 10in; max height, 6ft 4in; max usable floor area (less flight deck), 240 sq ft; dimensions of door, 59 × 31.5in; max seats, 40.

Fuel capacity: 1,030 Imp gal (1,235 US gal).

Performance: Cont cruising speed, 200kt (230 m.p.h.) at 6,550ft and 37,480lb; fuel consumption in this condition, 875lb/hr; balanced field length at max take-off weight, SL, ISA, 3,360ft; landing distance from 50ft, 2,840ft; range A (max payload), 1,090 n.m. (1,250 st.m.).

CHINESE STATE AIRCRAFT INDUSTRY—see under Peking.

CONVAIR *Convair Division of General Dynamics Corporation, San Diego 12, California, USA.*

Consolidated PBY-5A (Catalina) About 56 of these amphibians—conversions of US Navy PBY-5s, RAF Catalinas and RCAF Cansos—are still in service, notably with Pacific Western, Panair do Brasil and TransAir (Canada). *Flight* reference: November 20, 1959.

Convair 240 The prototype CV-240 flew on March 16, 1947, and the first deliveries, to American Airlines, were made less than a year later; services started on June 1, 1948. The design achieved considerable success, and was ordered in quantity by American, Western, PanAm and Continental, and in Europe by KLM, Sabena and Swissair. Some 120 are still in service. The fuselage was pressurized and offered with either rear or fuselage-side passenger loading. Until June 1948, the basic price was less than £100,000. Used price today is about £40,000. *Flight* reference, including full data: November 20, 1959.

Powerplant: Two Pratt & Whitney R-2800-CA18 of 2,400 b.h.p. each for take-off driving Hamilton 13ft 1in propellers.

Convair 340 Direct successor to the Convair 240, the 340 has a longer fuselage, additional wing area, higher maximum weight and greater power. There were a number of other design improvements, including a new flap arrangement. The 340 is equipped with folding stairs in an entrance on the port, instead of the starboard side as on the 240. The first 340 contracts were signed early in 1951 and the prototype made its first flight on October 5, 1951. Over 200 were built for civil use and 190 are still in service with 20 airlines. *Flight* references, including full data: November 20, 1959.

Powerplant: Two Pratt & Whitney R-2800-CB16/17 of 2,500 b.h.p. each driving Hamilton 13ft 6in propellers.

Convair 440 As was to be expected, the 340 all-up weight did not long remain at 47,000lb, and in the CV-440 Metropolitan it reached 49,700lb. Soundproofing was considerably improved, and a new thrust-augmenting exhaust system, with its rectangular exit nozzle above the wing trailing edge, is a distinguishing feature of the 440. The first flight of this version was made on December 16, 1955. The majority of the 153 Metropolitans built are still in service, the principal operators being Eastern (20), REAL (14), Sabena (9), SAS (20) and Swissair (11). The aircraft was described in *Flight*, July 6, 1956. There have been few sales of used CV-440s in the past year and the current price is uncertain.

Powerplant: As 340.

Dimensions: As 340 except length, 81ft 6in (includes nose radar).

Weight: Max take-off, 49,000lb; landing, 47,650lb; zero fuel, 47,600lb; capacity payload, 14,200lb; weight less fuel and payload, 32,800lb.

Payload accommodation: As 340.

Fuel capacity: As 340.

Performance: Continuous cruising speed, 250kt (289 m.p.h.) at 20,000ft and 45,000lb; field length (CAR 4b Part 40), max take-off weight, SL, ISA, 5,680ft; landing distance from 50ft, 4,060ft; range A (max payload), 409 n.m. (470 st.m.) with 1,650lb reserve fuel; range B (max fuel), 1,635 n.m. (1,880 st.m.) with 1,650lb reserve fuel.

Convair 540 This is the designation given to a CV-340 or CV-440 converted to Napier Eland turboprop power. (New production Eland Convairs are known as *Canadair* 540s—see page 793.)

So far, the only operator of Convair 540s is Allegheny Airlines, who are operating two Napier (and PacAero) converted aircraft—one 340 and one 440. The first conversion was completed in 1955 at Luton and US certification was obtained on August 22, 1958. Nine 340s have also been bought by Napier for conversion as required. Allegheny commenced operations, at first on a trial basis, on July 1, 1959, have ordered four more Convair 540 conversions and bought 14 traded-in Convair 340/440s from Lockheed; seven of these are in service and four have been converted to 540 standard. Butler Aviation in Washington have modified the interiors to 52 seats and Eland conversions are undertaken by AiResearch.

Flight references: July 25, 1958; August 29, 1958; February 6, 1959; November 20, 1959; December 11, 1959; January 29, 1960 and May 27, 1960. Conversion cost is about £160,000.

Allison-Convair 340/440 Conversion of Convair 340s and 440s to turboprop power is also offered by the Allison Division of General Motors Corporation. The same powerplant as that of the Lockheed Electra, the Allison 501-D13 driving Aeroproducts 606 propellers, can be fitted. Such a conversion has been made to a 1950 CV-240 previously fitted with T-38s.

A similar conversion was undertaken on one of two military CV-340s (YC-131Cs) which had been modified in 1955 to take Allison YT-56s—forerunner of the 501-D13. Conversions can be completed in 60 days at a cost of about £175,000. They include changes to the nacelle and wing structure, a fin extended by 1ft, larger-area rudder, a 40in increase in tailplane span and 17 sq ft increase elevator area, larger tabs, and re-arranged cockpit instruments and controls.

The aircraft was described in *Flight* of July 25, 1958.

Powerplant: Two Allison 501-D13 turboprops of 3,750 e.h.p. each driving 13ft 6in Aeroproducts 606 propellers.

Dimensions: As Convair 340/440.

Weights: Max take-off, 53,200lb; landing, 50,670lb; zero fuel, 4,500lb; capacity payload, 11,530lb; weight less fuel and payload, 33,470lb.

Payload accommodation: As Convair 340/440.

Fuel capactiy: 1,440 Imp gal (1,730 US gal).

Performance: Typical cruise speed, 298kt (343 m.p.h.) at 20,000ft and 48,000lb; corres specific fuel consumption, 0.484; balanced field length, max take-off weight, sea level, ISA, 4,750ft; sea level, ISA+15°C, 5,530ft; 5,000ft ISA, 6,400ft; landing distance from 50ft, 4,370ft; range A (max payload), 790 n.m. (910 st.m.); range B (max fuel), 1,610 n.m. (1,850 st.m.); corres payload, 8,000lb; corres cruise speed, 298kt (343 m.p.h.).

Convair 880 of Delta (G.E. CJ-805-3 turbojets)

Convair 880 Convair flew their first CV-880 for the first time on January 27, 1959, beating by three days the target set in June 1956. Embarking on the design of a jet transport later than Boeing or Douglas, they were able to put the later timescale to good account; the Convair 880 is faster than the 707 or DC-8 by a significant margin. The Convair 600 (see below) is faster still, and almost reaches the peak of economically feasible subsonic performance.

Since the 880 was first announced—as the "Skylark 600," later "Golden Arrow"—the maximum weight has grown steadily. Two versions were originally proposed, the long-range "international" Model 31 and the domestic Model 22. The former was at first ordered by Swissair, prior to conversion of their order to Convair 600s, but this model has now been scrapped. Versions offered by Convair now are the basic **Convair 880 Model 22 and the Convair 880M.** First flight was on January 27, 1959, FAA certification was received on May 1, 1960, and commercial services were started by Delta on May 15. Orders for Convair jet transports now total 94, TWA (10) and Delta (13) now being the only customers for the basic 880. Seven have been delivered to Delta but, for the moment, deliveries to TWA are delayed by the latter's financing problems. No current price is quoted by Convair; three years ago it was said to be £1.15m.

Flight reference: June 17, 1960.

Convair 880 Model 22

Powerplant: Four General Electric CJ-805-3 turbojets of 11,200lb static thrust.

Dimensions: Span, 120ft; length, 129ft 4in; height empty, 36ft 4in; wing area, 2,000 sq ft; sweepback at ¼ chord, 35°.

Weights: max take-off, 184,500lb; max landing, 132,800lb; zero fuel, 117,000lb; capacity payload (first-class space limited), 23,150lb; weight less fuel and payload, 88,615lb.

Payload accommodation: Cabin volume (less flight deck) 4,750 cu ft; baggage and freight volume, 863 cu ft; cabin length, 89ft 3in; max internal width, 10ft 8in; max height, 7ft 1in; max usable floor area (less flight deck), 922 sq ft; dimensions of largest door, 74in × 30in; max seats, 144 at 34in pitch.

Fuel capacity: 8,896 Imp gal (10,684 US gal).

Performance: Typical cruising speed, 483kt (557 m.p.h.) TAS at 35,000ft and 150,000lb; corres consumption 1,606 US gal/hr; balanced field length, max take-off weight, SL, ISA, 8,200ft; ISA + 15°C, 9,450ft; 5,000ft, ISA, 12,100ft; landing distance from 50ft, 6,180ft; range A (max payload), not stated; range B (max fuel), 3,530 n.m. (4,065 st.m.); cruise, Mach 0.89; V_{NE}, 380kt (438 m.p.h.) EAS; V_{NO}, 375kt (432 m.p.h.) EAS; V_{SO}, 110kt (127 m.p.h.) EAS.

Convair 880M This is a modified version (M stands for modified) of the Convair 880 Model 22, tailored for shorter ranges and to reduce turn-around time on the ground. It was announced in October 1959. Modifications include the addition of four leading-edge slats on each wing; power-boosted rudder and larger fin; provision for pre-loaded baggage bins; structural provision for 10,436 Imp gal fuel in three-bay centre-section tanks; CJ-805-3Bs of 450lb additional thrust each; strengthened undercarriage associated with greater max weight (191,000lb); retractable tail skid and an improved anti-skid braking system. Orders for Convair 880Ms have been placed by Japan Air Lines, 3; CAT, 1; Avensa, 1; FAA, 1; unidentified purchaser, 7; Alaska Airlines, 1. First flight was on October 3 this year and certification is expected next April.

Flight reference: March 25, 1960.

Convair 880M Model 22M

Powerplant: Four General Electric CJ-805-3B turbojets of 11,650lb static thrust.

Dimensions: As Model 22.

Weights: Max take-off, 191,000lb; max landing, 155,000lb; zero fuel, 121,500lb; capacity payload, 23,150lb.

Payload accommodation: As Model 22.

Fuel capacity: 10,436 Imp gal (12,534 US gal).

Performance: Optimum-cost cruise, 483kt (557 m.p.h.) TAS at 30,000ft and 150,000lb; corres fuel consumption, 1,526 US gal/hr; range A (max payload), not stated; range B (max fuel), 4,390 n.m. (5,056 st.m.); corres payload, 16,787lb; cruise Mach, 0.89; V_{NE}, V_{NO}, as Model 22; V_{SO}, 101kt (116 m.p.h.) EAS.

Convair 600 Largest, heaviest and fastest of the family, the 600 was designed to carry up to 139 passengers, to have US transcontinental range and to fly faster than any other commercial transport. Fuselage length was increased by 10ft, max weight raised to 244,200lb, and the aircraft area-ruled by the addition of substantial anti-shock bodies extending beyond the trailing edge of the wing (parts of these provide extra fuel storage). The claimed maximum cruising speed is Mach 0.91 (up to 625 m.p.h.). There are two models, the **Convair 600 Domestic** (as ordered by American Airlines) and the **Convair 600 International** (as ordered by SAS/Swissair).

American Airlines placed the first order for CV-600s, for 25 (with an additional 25 on option) to be delivered from June 1961. In general it is the CV-600 that is offered for sale overseas. The SAS/Swissair consortium has ordered nine, giving the 600 the class name **Coronado.** The first flight should take place in late December, and eight-and-a-half months will be devoted to flight tests. Orders have been placed by American Airlines, 25; Swissair, 7; SAS, 2; REAL, 3. Price, fully equipped, is about £2.2m. References; June 17, 1960. *Flight* cutaway drawing, pages 796/797.

Convair 600 Domestic

Powerplant: Four General Electric CJ-805-23 turbofans of 16,100lb static thrust.

Dimensions: Span, as Model 22; length, 139ft 2in; height empty, 39ft 6in; wing area, 2,250 sq ft; sweepback, 35°.

Weights: Max take-off, 239,200lb; max landing, 180,000lb; zero fuel, 154,000lb; capacity payload, 25,120lb; weight less fuel and payload, 115,833lb.

Above, de Havilland Dove 8 (Gipsy Queen 70 Mk 3). Below, Curtiss C-46 (P & W R-2800 Double Wasps)

Payload accommodation: Cabin volume (less flight deck), 5,120 cu ft; baggage and freight volume, 928 cu ft; cabin length, 89ft 9in; max internal width, 10ft 8in; max height, 7ft 1in; max usable floor area (less flight deck), 1,022 sq ft; dimensions of largest door, 74in × 30in; max seats, 159 at 34in pitch.

Fuel capacity: 13,333 Imp gal (15,108 US gal).

Performance: Optimum-cost cruising speed, 496kt (571 m.p.h.) TAS at 35,000ft and 190,000lb; corres fuel consumption, 1,658 US gal/hr; balanced field length, max take-off weight, SL, ISA, 8,600ft; ISA + 15° C, 9,800ft; 5,000ft, ISA, 13,100ft; range A (max payload), not stated; range B (max fuel), 4,741 n.m. (5,460 st.m.); cruise Mach, 0.91; V_{NE}, 439kt (506 m.p.h.) EAS; V_{NO}, 394kt (455 m.p.h.) EAS; V_{SO}, 101kt (116 m.p.h.) EAS.

Convair 600 Intercontinental

Powerplant: As Domestic model.

Dimensions: As Domestic model.

Weights: Max take-off, 244,000lb; max landing, 180,000lb; zero fuel, 154,000lb; capacity payload, 27,893lb; weight less fuel and payload, 124,567lb.

Payload accommodation: As Domestic model.

Fuel capacity: 13,050 Imp gal (15,672 US gal).

Performance: As Domestic model except, range B (max fuel), 4,850 n.m. (5,585 st.m.); corres payload, 15,433lb.

Convair Model 60 Now being offered to the airlines is a smaller partner to the Convair 880/600 family—the Model 60. A twin, powered by Pratt & Whitney JT3D-10 turbofans or GE CJ805-41C1s, aerodynamic, systems and structural design is said to borrow heavily from the Convair 880. Operating costs over a 1,200 n.m. range are reputed to be 1.4 cents per seat n.m. in an 85-passenger layout, but another version with four-abreast seating, could accommodate 68 passengers at 38in pitch. No price has been stated. *Flight* references: May 27, 1960 and August 12, 1960.

Powerplants: Two Pratt & Whitney JT3D-10 turbofans of 20,000lb thrust each or two General Electric CJ805-41C1 turbofans of 22,000lb thrust each.

Dimensions: Span, 120ft; length, 109ft 5in; height, 36ft 3in; wing area, 2,000 sq ft; sweepback 35° at 30 per cent chord.

Weights: Max take-off, 145,000lb; max landing, 140,000lb; max zero fuel, 102,000lb; operating weight empty (85-seat version), 80,860lb.

Performance: Max cruise speed at max cruise thrust at 110,000lb, 586 m.p.h. at 19,000ft; 508kt (585 m.p.h.) at 25,000ft; 500kt (576 m.p.h.) at 30,000ft; range with normal payload, max cruise thrust at 25,000ft, over 1,600 n.m. (1,840 st.m.).

CURTISS

CW-20/C-46 (Commando) The pressurized Curtiss CW-20 prototype first flew on March 26, 1940. It was later redesigned to have a single fin and rudder, and was taken over by the USAAF under the designation C-55-CS. It was acquired by BOAC in 1941. Production for the airlines was forestalled by Pearl Harbor, but a total of 3,181 unpressurized military transport versions were built for the USAAF as the C-46 Commando, powered by Pratt & Whitney R-2800 Double Wasps. A post-war commercial version, the CW-20E, was planned but abandoned after Eastern Air Lines cancelled an order. But after 1945 many war-surplus C-46s were acquired by commercial operators, especially in North and Latin America, where 356 Commandos are now used by 91 carriers, although only 35 are used outside the Americas (by ten airlines).

The CW-20T version (*Flight*, May 4, 1956), evolved by Air Carrier Engineering Services and the L.B. Smith Aircraft Corp of Miami, was awarded an unrestricted CAA certificate in 1956 as the result of some 30 engine and airframe improvements. In March 1958 L. B. Smith obtained approval at 50,100lb max weight for another modified version known as the Super 46C; in November 1958 this weight was increased to 50,650lb. Riddle Airlines, largest commercial operator of C-46s, produced a broadly similar conversion, the **C-46R**, which was awarded a transport-category certificate in March 1957 (*Flight*, November 28, 1958). Current second-hand market prices being asked range from about £20,000 for C-46F conversions to £60,000 for the C-46R.

Data for the C-46A, C-46D and C-46F appeared in *Flight* for November 20, 1959, page 593.

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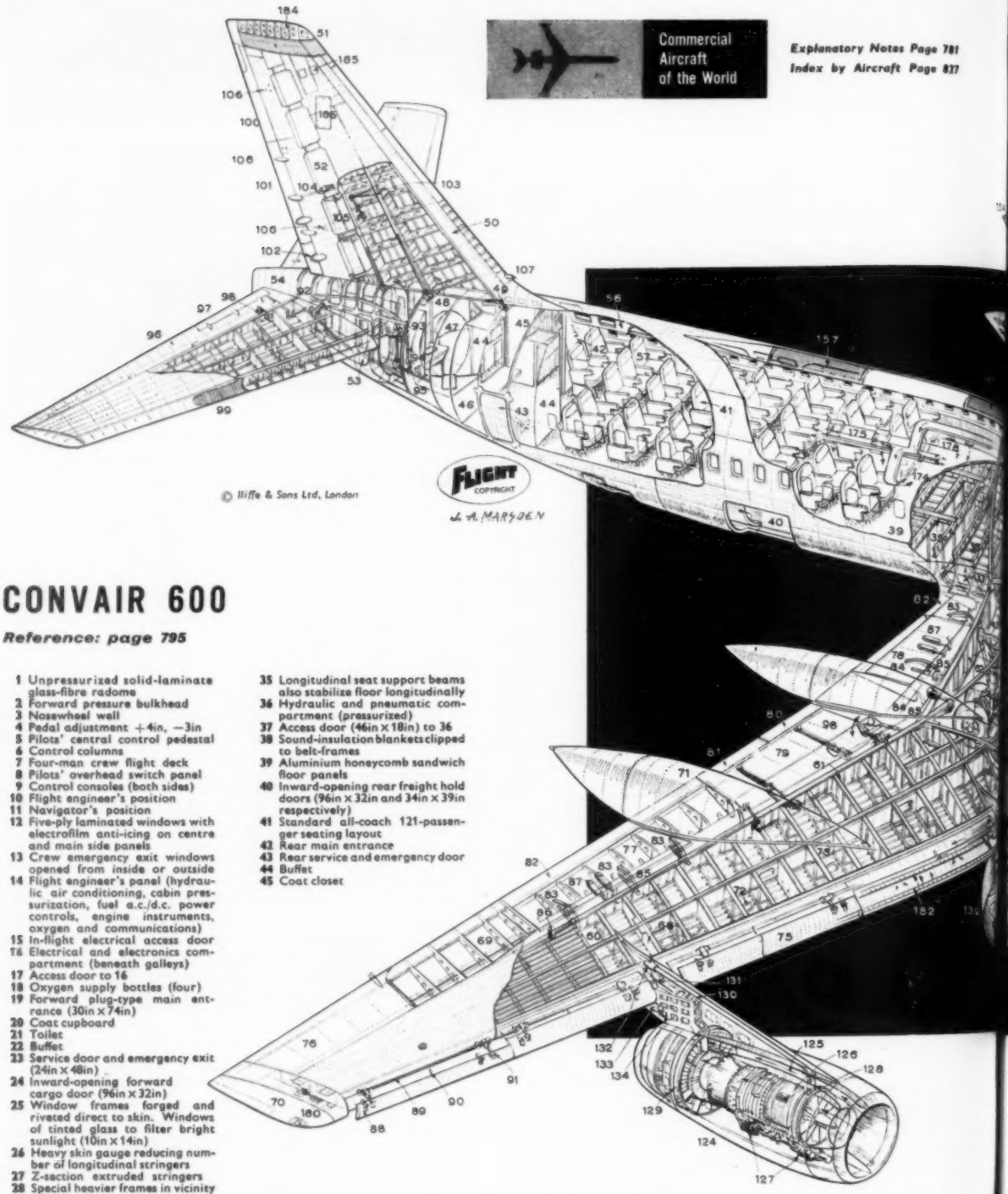
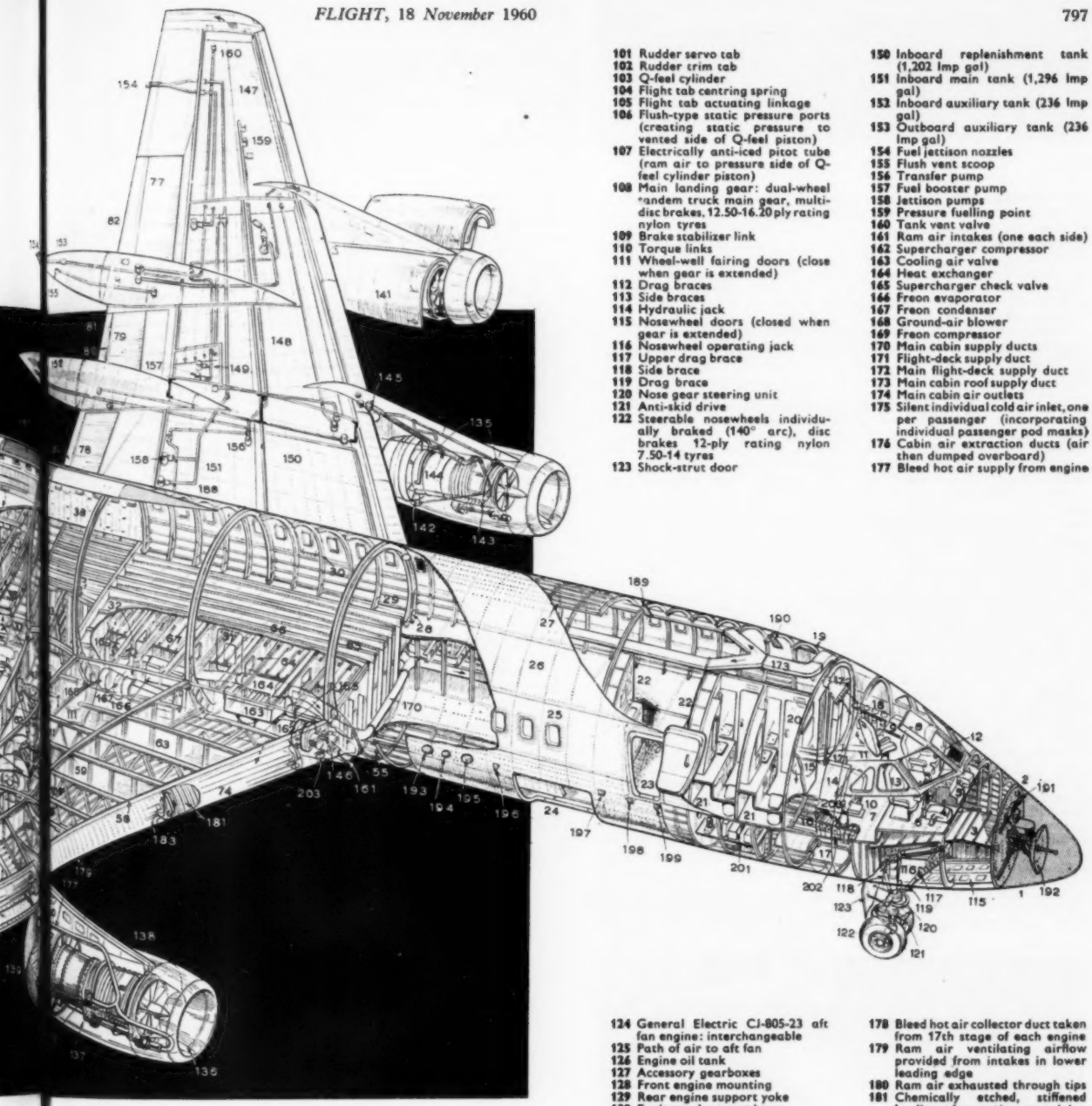


CONVAIR 600

Reference: page 795

1 Unpressurized solid-laminate glass-fibre radome
2 Forward pressure bulkhead
3 Nosewheel well
4 Pedal adjustment +4in, −3in
5 Pilots' central control pedestal
6 Control columns
7 Four-man crew flight deck
8 Pilots' overhead switch panel
9 Control consoles (both sides)
10 Flight engineer's position
11 Navigator's position
12 Five-ply laminated windows with electrofilm anti-icing on centre and main side panels
13 Crew emergency exit windows opened from inside or outside
14 Flight engineer's panel (hydraulic air conditioning, cabin pressurization, fuel a.c./d.c. power controls, engine instruments, oxygen and communications)
15 In-flight electrical access door
16 Electrical and electronics compartment (beneath galleys)
17 Access door to 16
18 Oxygen supply bottles (four)
19 Forward plug-type main entrance (30in x 74in)
20 Coat cupboard
21 Toilet
22 Buffet
23 Service door and emergency exit (24in x 48in)
24 Inward-opening forward cargo door (96in x 32in)
25 Window frames forged and riveted direct to skin. Windows of tinted glass to filter bright sunlight (10in x 14in)
26 Heavy skin gauge reducing number of longitudinal stringers
27 Z-section extruded stringers
28 Special heavier frames in vicinity of wing-to-fuselage joints
29 Additional stringers in highly loaded portions of fuselage (such as wing attachments and exits)
30 Belt-frame spacing in cabin (19in)
31 Emergency exits (20in x 36in)
32 Air conditioning and pressurization equipment bay beneath wing centre section (unpressurized)
33 Main wheel well with dividing deep-keel member
34 Transverse built-up floor beams (tee caps and stiffened web) without vertical support members reduces shock in belly landing
35 Longitudinal seat support beams also stabilize floor longitudinally
36 Hydraulic and pneumatic compartment (pressurized)
37 Access door (46in x 18in) to 36
38 Sound-insulation blankets clipped to belt-frames
39 Aluminium honeycomb sandwich floor panels
40 Inward-opening rear freight hold doors (96in x 32in and 34in x 39in respectively)
41 Standard all-coach 121-passenger seating layout
42 Rear main entrance
43 Rear service and emergency door
44 Buffet
45 Coat closet
46 Toilets port and starboard
47 Rear pressure bulkhead
48 Three-spar box beam fin
49 Six aluminium-alloy forgings providing shearbolt fin/fuselage connections
50 Three-piece detachable, non-structural leading edge
51 Removable aluminium-alloy tip
52 Aluminium honeycomb shrouds attached to rear-spar caps on both surfaces to cover rudder balance boards and act as an aerodynamic seal
53 Rear fuselage afterbody
54 Tail cone
55 Machined external longeron between front and rear holds ensures structural continuity
56 Light luggage racks containing emergency oxygen sets
57 Passenger-seats with built-in folding tray for food service and/or writing table
58 Front spar supports engine pylons and leading edge
59 Centre spar similar to front spar, but terminating at web outboard of outboard pylon
60 Rails become heavy stringers continuing to wingtip rib
61 Rear spar: construction similar to front spar except for splices, continuous through fuselage, supports flaps, ailerons and spoilers, also carries main landing gear forward trunnion
62 Auxiliary wing spar: carries rear landing gear trunnion
63 Web-type ribs alternate with plate ribs, full intercostalling used on ribs that have high concentrated loads
64 Four centre transverse spars
65 Fore and aft beams: cabin floor attaches directly to these, eliminating floor beams in fuselage belt-frames
66 Spanwise skin splice extends from front and rear spar on centre section centre line



67 Centre tie box sealed for fuel (2,580 Imp gal)
68 Fuel tanks formed integral with Scotch-Weld leakproof wing structure and separated by fuel-tight bulkheads
69 Mill-tapered Z-section extruded stringers on upper and lower skinning
70 Four-point detachable wing-tip and nav. light
71 Aerodynamic anti-shock bodies
72 Fuel-tank access doors
73 Access holes in main inter-spar
74 Chemically-etched, stiffened leading edge containing bleed air anti-icing ducts
75 Leading edge extended slats containing anti-icing
76 Fixed outer-wing trailing edge (aluminium honeycomb sandwich)
77 Outboard upper surface spoilers (travel: 60°)
78 Inboard upper surface spoilers: used symmetrically for speed brakes, or at high speed differentially for roll (travel: 60°)
79 Balance board servo-tab-operated inboard ailerons interconnected with spoilers
80 Aileron trim tab
81 Aileron servo tab
82 Double-slotted Fowler flaps
83 Flap extension rails
84 Flap gearbox and screwjack
85 Flap torque tube and gearboxes
86 Asymmetric flap shut-off unit
87 Spoiler actuator jacks
88 Slat jack
89 Torque tube
90 Engagement hook
91 Slat screwjack
92 Tailplane pivot point (2½° up, 15° down)
93 Tailplane follow-up mechanism
94 Follow-up shaft
95 Tailplane control torque tube
96 Servo-tab-operated elevators
97 Elevator servo tab
98 Gust damper (preventing damage to the surfaces by wind)
99 Leading-edge electrical anti-icing heating strips
100 Servo-tab-operated mass balanced rudder
101 Rudder servo tab
102 Rudder trim tab
103 Q-feel cylinder
104 Flight tab centring spring
105 Flight tab actuating linkage
106 Flush-type static pressure ports (creating static pressure to vented side of Q-feel piston)
107 Electrically anti-iced pitot tube (ram air to pressure side of Q-feel cylinder piston)
108 Main landing gear: dual-wheel tandem truck main gear, multi-disc brakes, 12.50-16.20 ply rating nylon tyres
109 Brake stabilizer link
110 Torque links
111 Wheel-well fairing doors (close when gear is extended)
112 Drag braces
113 Side braces
114 Hydraulic jack
115 Nosewheel doors (closed when gear is extended)
116 Nosewheel operating jack
117 Upper drag brace
118 Side brace
119 Drag brace
120 Nose gear steering unit
121 Anti-skid drive
122 Steerable nosewheels individually braked (140° arc), disc brakes 12-ply rating nylon 7.50-14 tyres
123 Shock-strut door
124 General Electric CJ-805-23 aft fan engine: interchangeable
125 Path of air to aft fan
126 Engine oil tank
127 Accessory gearboxes
128 Front engine mounting
129 Rear engine support yoke
130 Engine pod support beam
131 Engine brace to wing
132 Pod support beam to wing
133 Fire-detector panel
134 Two-shot fire extinguisher
135 Fire extinguisher nozzles
136 Detachable nosecone, anti-iced using turbine bleed air
137 Aluminium skins below centre-line
138 Titanium skins above centre-line isolating wing from pod in case of fire
139 Gate (target type) reverser (shown in reverse position)
140 Reverser actuator
141 Hinged panels giving complete access to powerplant
142 Reverser control valve
143 Fuel shut-off and power control torque box
144 Engine control cable run
145 Pylon torque box
146 Pressure seals for engine control runs
147 Outer replenishment tank (532 Imp gal)
148 Outer main tank (1,490 Imp gal)
149 Well-type tank (130 gal approx.) to prevent fuel starvation during manoeuvres
150 Inboard replenishment tank (1,202 Imp gal)
151 Inboard main tank (1,296 Imp gal)
152 Inboard auxiliary tank (236 Imp gal)
153 Outboard auxiliary tank (236 Imp gal)
154 Fuel jettison nozzles
155 Flush vent scoop
156 Transfer pump
157 Fuel booster pump
158 Jettison pumps
159 Pressure fuelling point
160 Tank vent valve
161 Ram air intakes (one each side)
162 Supercharger compressor
163 Cooling air valve
164 Heat exchanger
165 Supercharger check valve
166 Freon evaporator
167 Freon condenser
168 Ground-air blower
169 Freon compressor
170 Main cabin supply ducts
171 Flight-deck supply duct
172 Main flight-deck supply duct
173 Main cabin roof supply duct
174 Main cabin air outlets
175 Silent individual cold air inlet, one per passenger (incorporating individual passenger pod masks)
176 Cabin air extraction ducts (air then dumped overboard)
177 Bleed hot air supply from engine
178 Bleed hot air collector duct taken from 17th stage of each engine
179 Ram air ventilating airflow provided from intakes in lower leading edge
180 Ram air exhausted through tips
181 Chemically etched, stiffened leading-edge section containing bleed-air anti-icing ducts
182 Perforated leading-edge duct
183 Hot air from (182) passes over leading edge in etched grooves, then discharged beneath wing
184 HF communications aerial housed in 10in-wide glass-fibre structure, installed to serve as aerial insulation
185 HF coupler
186 VHF navigation aerial
187 ADF sense aerial
188 No 2 VHF aerial
189 No 3 VHF aerial
190 No 2 DMET
191 Glide-path aerial
192 Cloud-collision warning radar
193 ADF loop
194 Marker
195 ADF loop
196 ATC radar beacon
197 No 1 VHF communication aerial
198 ATC radar beacon
199 No 1 DMET
200 a.c./d.c. distributors
201 Transformer rectifiers
202 Directional gyros, autopilot, etc., and tape reproducer, Doppler computer provisional
203 Landing lights (port and stbd.)

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DE HAVILLAND *The de Havilland Aircraft Co. Ltd, Hatfield, Herts. (Member of the Hawker Siddeley Group.)*

D.H.89 Dragon Rapide Known as the Dragon Six when it first flew in April 1934, the Rapide was designed to provide air transport that would pay its way on a very limited flow of traffic. A total of 697 Rapides were built, of which 102 are still in service with 42 airlines. Last development was the Rapide 6, with Fairey X5 propellers giving an increased take-off weight of 6,000lb and an improved payload.

Flight reference: November 20, 1959, page 593.

Powerplant: Two de Havilland Gipsy Queen 3 of 205 b.h.p. each.

D.H.104 Dove 8 First flown on September 25, 1945, the Dove was marketed as an "airliner in miniature." Over 500 have been built—more than any other British transport—and 55 are currently in service with 27 airlines.

The Dove 8—faster and longer-ranging with improved ejector exhaust Gipsy Queen 70s—is directed primarily at the executive market, with a luxurious interior for up to six passengers. In the USA, where cabin schemes are executed to customer requirements by a specialist firm, this new Dove is known as the **Dove Custom 800.** The deeper Heron canopy is fitted and the instrument panel is restyled. Twelve are being built, one of the two demonstrators being based in the USA.

D.H.106 Comet 4 The Comet 4 stems from the Comet 1 which first flew on July 27, 1949, and which BOAC, UAT, and Air France operated from 1952-1954. The Comet 4 is a revised version of the long-fuselage prototype Comet 3, with more power, range and payload and incorporating the structural knowledge gained in the accidents of 1954. The first of 19 Comet 4s for BOAC made its initial flight on April 27, 1958, and BOAC inaugurated the first transatlantic jet services with these aircraft on October 4, 1958, following with Comet services to India, Hong Kong, Japan, Australia and South America. The corporation withdrew Comet 4s from the North Atlantic route on October 16, 1960. Aerolineas Argentinas operates Comet 4s from Buenos Aires to Santiago de Chile, New York and Europe. Two more Comet 4s have been delivered to East African Airways Corporation.

Flight references: March 28, 1958; July 25, 1958, October 24, 1958. Basic price: £1.14m.

Powerplant: Four Rolls-Royce Avon 524 RA.29/1 turbojets of 10,500lb thrust each.

Dimensions: Span, 115ft; length, 111ft 6in; height, 29ft 6in; wing area, 2,121 sq ft.

Weights: Max take-off, 162,000lb; landing 120,000lb; zero fuel, 99,000lb; capacity payload (60-seat, first class), 20,286lb; weight less fuel and payload (60-seat, first-class), 75,424lb.

Payload accommodation: Cabin volume, 2,815 cu ft; baggage and freight volume, 570 cu ft; cabin length, 71ft 8in; max width, 9ft 7in; max height, 6ft 6½in; usable floor area, 439 sq ft; entrance door dimensions, 56in × 30in; max seats, 81 at 34in pitch.

Fuel capacity: 8,898 Imp gal.

Performance: Optimum-cost cruising speed, 438kt (505 m.p.h.) at 28,000ft and 130,000lb with fuel consumption of 9,650lb/hr; balanced field length, max take-off weight, sea level, ISA, 6,750ft; landing field length, max landing weight, sea level, ISA, 6,630ft; range A (max payload), 3,500 n.m. (4,030 st.m.) (81-seat tourist); range B (max fuel), 3,790 n.m. (4,360 st.m.) with 15,476lb; cruise Mach, 0.74; V_{NE}, 300kt (345 m.p.h.) IAS; V_{NO}, 290kt (334 m.p.h.); V_{SO}, 94kt (108 m.p.h.) at 115,000lb.

Above, de Havilland D.H.121 Trident Mk 1 of BEA (Rolls-Royce RB.163 turbojets). Below, de Havilland Canada D.H.C.3 Otter of Qantas (P & W R-1340 Wasp)

D.H.106 Comet 4B The Comet 4B was evolved to BEA's requirements for a "first-generation" jet. Ten 4Bs were ordered by BEA and four were ordered by Olympic Airways. Main difference compared with the Comet 4 is a 6ft 6in longer fuselage seating up to 102 passengers. To allow higher cruising speeds at lower altitudes, wing span is reduced by 7ft 2in, and the Comet 4B's medium-range role enables the pod-type wing tanks to be deleted. BEA's initial contract for six was valued at "about £7m" with spares.

Powerplant: Four Rolls-Royce Avon 525B RA.29/1 turbojets of 10,500lb static thrust each.

Dimensions: Span, 107ft 10in; length, 118ft; height, 29ft 6in; wing area, 2,059 sq ft.

Weights: Max take-off, 158,000lb; landing, 120,000lb; zero fuel, 102,500lb; capacity payload, 24,137lb; weight less fuel and payload, 78,363lb.

Payload accommodation: Cabin volume, 3,160 cu ft; baggage and freight volume, 640 cu ft; cabin length, 78ft 2in; max width, 9ft 7in; max height, 6ft 6½in; usable floor area, 529 sq ft; entrance door dimensions, 56in × 30in; max seats, 101 at 34in pitch.

Fuel capacity: 7,813 Imp gal.

Performance: Optimum-cost cruising speed, 452kt (520 m.p.h.) at 23,500ft and 135,000lb, with fuel consumption of 11,500lb/hr; balanced field length, max take-off weight, sea level, ISA, 6,600ft; sea level, ISA +15°C, 7,450ft; at 5,000ft, ISA, 9,300ft landing field length, max landing weight, sea level, ISA, 6,660ft; range A (91-seat tourist), 2,910 n.m. (3,350 st.m.); range B (max fuel), 3,240 n.m. (3,730 st.m.) at 405kt (465 m.p.h.) with 17,131lb; cruise Mach 0.74; V_{NE}, 335kt (409 m.p.h.) IAS; V_{NO}, 320kt (368 m.p.h.) IAS; V_{SO}, 95kt (109 m.p.h.) EAS at 115,000lb.

D.H.106 Comet 4C The Comet 4C is the intermediate-range version of the Comet family. It combines the 4B's longer fuselage with the Comet 4's wing and fuel tankage; this enables it to carry more payload than the Mark 4 at a slight sacrifice in maximum range. Three have been ordered by Mexicana, three by United Arab Airlines (Misrair), and four by MEA. RAF transport Command is to have five.

Powerplant: Four Rolls-Royce Avon 524 RA.29/1 turbojets of 10,500lb static thrust each.

Dimensions: As Comet 4, except length, 118ft.

Weights: As Comet 4B, except weight less fuel and payload (72-seat first-class), 77,500lb.

Payload accommodation: As Comet 4B.

Fuel capacity: As Comet 4B.

Performance: Optimum-cost cruising speed, 435kt (500 m.p.h.) at 33,000ft and 135,000lb with fuel consumption of 8,800lb/hr; balanced field length, max take-off weight, sea level, ISA, 6,350ft; sea level, ISA +15°C, 7,100ft; 5,000ft, ISA, 8,750ft; landing field length, max landing weight, sea level, ISA, 6,570ft; range A (max payload) 3,075 n.m. (3,560 st.m.) (91-seat tourist); range B (max fuel), 3,780 n.m. (4,350 st.m.) (11,400lb); cruise Mach, 0.74; V_{NE}, 305kt (351 m.p.h.) IAS; V_{NO}, 275kt (317 m.p.h.) IAS; V_{SO}, 99kt (114 m.p.h.) EAS at 115,000lb.

D.H.114 Heron 1 and 2 Essentially a scaled-up, four-engined version of the Dove, the Heron was designed to bring "mainliner" standards to feeder-line routes. The Heron 1 prototype first flew on May 10, 1950. Initial production was of the Mk 1, which featured a fixed nosewheel undercarriage and non-feathering propellers. This version was superseded in production by the Heron 2, which has a retractable undercarriage and feathering propellers. About 150 Herons have been built, of which over 80 are in airline service. More are used by air forces, executive owners and by the Queen's Flight. Price new is about £60,000 less radio. Particulars below refer to the Heron 2.

Powerplant: Four D.H. Gipsy Queen 30 Mk 2s of 250 b.h.p. each driving de Havilland Hydromatic 2/1000/2 7ft propellers.

Dimensions: Span, 71ft 6in; length, 48ft 6in; height, 15ft 7in; wing area, 499 sq ft.

Weights: Max take-off, 13,500lb; landing, 13,150lb; zero fuel, 12,670lb; capacity payload, 3,750lb; weight less fuel and payload, 8,996lb (including 2 crew).

Payload accommodation: Cabin volume, 515 cu ft; baggage and freight volume, 127 cu ft; cabin length, 23ft; max width, 4ft 6in; max height, 5ft 9in; usable floor area, 89 sq ft; dimensions of largest door, 51in × 33.5in; max seats, 17.

Fuel capacity: 412 Imp gal (495 US gal).

Performance: Cruising speed, 159kt (183 m.p.h.) at 8,000ft and 13,000lb; balanced field length, 3,570ft; range B, 1,538 n.m. (1,771 st.m.) at 158kt (183 m.p.h.) with 1,320lb payload.

D.H.121 Trident Mk 1 BEA issued a general specification for a "second-generation" jet airliner to the British aircraft industry in July 1956. Not until February 1958, after a long drawn-out political controversy, were BEA allowed to place a provisional order for the D.H.121. Though de Havilland were prepared to finance the aircraft alone, in accordance with Government policy the Airco consortium was formed with Fairey and Hunting to design, manufacture and develop the D.H.121, which was named Trident in September 1960.

The original D.H.121 (*Flight*, July 25, 1958, p. 120) was an 111-seater (max) with a take-off weight of 123,000lb. Powerplant was three Rolls-Royce RB.141s of 12,000lb static thrust. During the early months of 1959, as RB.141 power increased, it became apparent that the 121 had grown too large for BEA's requirements. The design was revised around three Rolls-Royce RB.163s of 10,100lb static thrust each, with a max weight of 105,000lb and seating reduced to a maximum of 100.

The engines are rear-mounted, and the unique triple-turbojet formula is claimed to satisfy most efficiently the thrust requirements of take-off and cruise ("with four engines the aircraft would be overpowered on

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Douglas DC-3 of BEA (P & W R-1830)

take-off, and with two would be overpowered in the cruise"). The broad strategy of the 121 might be summed up as a 600 m.p.h. jet with a 6,000ft take-off and "optimized" economics for the shorter trunk-route stages of up to 1,000 miles.

A firm contract for 24 aircraft, for delivery to BEA from mid-1963, was signed on August 12, 1959. All 24 aircraft should be delivered by September 1965. First flight of the 121 should take place in December 1961. Six more aircraft will join the flight test programme in 1962. From the outset the Trident, with its triplex control system (Smiths), is designed for autoflare, with full automatic landing envisaged before 1970. Value of the BEA contract is £28m with spares.

Flight references: August 21, 1959, p. 57; August 28, 1959, p. 91; September 4, 1959, p. 102; January 22, 1960, pp. 102-104 and 120; February 19, 1960, pp. 238-240 (blind landing).

Powerplant: Three Rolls-Royce RB.163 by-pass turbojets of 10,100lb static thrust each.

Dimensions: Span, 89ft 10in; length, 114ft 9in; height, 27ft; wing area, 1,358 sq ft; sweepback, 35°.

Weights: Max take-off, 105,000lb, or 112,000lb with centre-section tankage; landing, 100,000lb; zero fuel, 85,500lb; capacity payload, 22,370lb; weight less fuel and payload, 63,130lb.

Payload accommodation: Cabin volume, 4,412 cu ft; baggage and freight volume, 620 cu ft; cabin length, 66ft 10½in (port side), 65ft 8in (starboard side); max width, 11ft 7½in; max height, 6ft 8in; max usable floor area, 708 sq ft; largest door, 62½in × 28in; max seats, 100 at 34in pitch.

Fuel capacity: 3,840 Imp gal, or 4,840 Imp gal with centre section tankage.

Performance: Opt. cost cruising speed at 32,000ft and 100,000lb, 508kt (585 m.p.h.); corres. fuel consumption, 7,300lb/hr; range A (max payload), 1,460 n.m. (1,680 st.m.) or 2,420 n.m. (2,790 st.m.) with centre-section tankage; range B (max fuel), 3,050 n.m. (3,520 st.m.) with 9,325lb payload; cruise Mach, 0.875; V_{NO}, 360kt (415 m.p.h.) EAS.

D.H.121 Trident Mk 2 First referred to by Sir Roy Dobson of Hawker Siddeley in March 1960, this is a project-study for a stretched development of the basic short-range Mk 1 intended for the medium-range market (2,000 miles-plus with max payload) at which the Boeing 727 and Vickers VC11 projects are aimed. Span and lift coefficient would be greater and, according to one report, sweepback would be reduced to 30°.

D.H.125 A project for a twin-jet (aft-mounted developed BS Vipers?) "Dove replacement," with 6-8 seats, the D.H.125 is one of two de Havilland tentative designs aimed at the small transport market, the other being :—

D.H.126 This is a larger twin-jet project, with aft-mounted fan engines, in the Heron-replacement category.

Ambassador The Airspeed A.S.57 Ambassador first flew on July 10, 1947 and entered service in 1952 with BEA, who named it Elizabethan. Until 1957, BEA was the only operator, but in that year three were sold to Butler Air Transport of Australia. Only 21 of these high-wing monoplanes were built, and today BKS Air Transport operate four, Dan-Air three, Overseas Aviation four, Shell two, Rolls-Royce one (Tyne test bed). Four Elizabethans are at present in BEA storage awaiting sale at £69,500 each with zero-time engines and airframes.

Powerplant: Two Bristol Centaurus 661s of 2,625 b.h.p. driving D.H. Hydromatic four-blade 16ft propellers.

Data appeared in *Flight of* November 20, 1959, page 597.

DE HAVILLAND AIRCRAFT PTY *P.O. Box 30, Bankstown, N.S.W., Australia.*

DHA.3 Drover First flown on January 23, 1948, the Drover was designed to Australian requirements as a post-war successor to the D.H.84 Dragon, with emphasis on simplicity (e.g. fixed undercarriage), ruggedness and a good performance with one engine inoperative. Only 20 Drovers were built, of which eight are in service with Fiji Airways, Qantas and TAA. The latter's Drovers are among six operated by the Royal Flying Doctor Service which have been re-engined with more powerful Lycoming O-360-A1A engines driving Hartzell propellers in place of the three Gipsy Major Mk 10s.

THE DE HAVILLAND AIRCRAFT OF CANADA *Downsview, Toronto, Ontario, Canada.*

DHC.2 Beaver The Beaver first flew on August 19, 1947. It has been found suitable for outback operation all over the world, and about 1,500 Beavers have been delivered and are in use in some 60 countries; 918 of these are L-20As of the USAF and US Army. An order has been placed by the British Army. Commercial Beavers have been used not only for passenger carrying, but for countless other duties. The one and only Beaver 2 is fitted with a 550 b.h.p. Alvis Leonides 502/4; standard powerplant is the 450 h.p. Wasp Junior.

DHC.3 Otter Developed, like the Beaver, for Canadian conditions, the Otter first flew on December 12, 1951 and, like the Beaver, is offered in landplane, seaplane, amphibian, skiplane or wheel-skiplane versions. The Otter is also used by airlines in Norway, Vietnam, Laos, Japan, the Philippines and New Guinea, while military Otters equip the air forces of Canada, Norway, Colombia and India, as well as the US Army (U-1A utility versions) and US Navy (UC-1 utility versions). Over 300 Otters have been built so far, of which more than 200 are U1As. Powerplant is the 600 h.p. P. & W. R-1340 Wasp.

DHC.4 Caribou The Caribou had its origin in design studies for a "Twin Otter" grossing 13,000lb, with two Otter-type powerplants and a fixed undercarriage. The Caribou's ultimate configuration was determined by US and Canadian Army desires for rear loading, and the need for good STOL characteristics and climb after take-off, together with a reasonable single-engined ceiling. The first of three prototypes made its maiden flight on July 30, 1958, and the first of a good number of YAC-1A Caribous for the US Army was delivered on October 8, 1959. Production aircraft feature a 3ft 9in longer fuselage. So far no commercial sales have been made.

Powerplant: Two Pratt & Whitney R-2000-7M2 Twin Wasps of 1,450 b.h.p. each driving 13ft 1in Hamilton Standard propellers.

Data appeared in *Flight* for November 20, 1959, page 597.

DOUGLAS *The Douglas Aircraft Company, Santa Monica, California, USA.*

DC-3 The most famous and widely-used airliner ever built, the DC-3 occupies a unique position in air transport. It is a twin-engined unpressurized aeroplane capable of carrying 20-30 passengers on stages of up to about 1,000 miles at a cruising speed of about 170 m.p.h. It set entirely new standards in airliner design and operation which were universally accepted and copied.

The DC-3 is a development of the DC-1 and DC-2 (designed for TWA) which, with the Boeing 247 (designed for United), were the first airliners of the modern stressed-skin all-metal cantilever low-wing monoplane formula. It made its first flight on December 22, 1935, having itself originally been designed to meet an American Airlines requirement for a sleeper version of the DC-2 suitable for use on the longer trunk US domestic routes. However, it was the "Day Plane" model of the "Douglas Sleeper Transport" which became the DC-3. All told, a total of 10,928 DC-3s and military C-47s were built in the United States, in addition to about 2,000 under licence in Russia and 450 in Japan. Some 1,672 are still in service with 235 airlines—nearly as many as all other types of airliner taken together. The DC-3 in 1936 cost £18-23,000 and resale prices today are around £25,000.

Powerplant: Two Pratt & Whitney R-1830-92s of 1,200 b.h.p. driving three-bladed Hamilton Standard Hydromatic 11ft 6in propellers.

Dimensions: Span, 95ft; length, 64ft ½in; height, 16ft 11½in; wing area, 987 sq ft.

Weights: Max take-off, 25,200lb (US passenger), 26,900lb (US freight), 28,000lb (UK); landing, 24,400lb (US passenger), 26,900lb (UK and US freight); no zero fuel restriction; capacity payload, 5,380lb; weight less fuel and payload, 17,720lb.

Payload accommodation: Cabin volume, 1,245 cu ft; baggage and freight volume, 160 cu ft; cabin length, 30ft ½in; max width, 7ft 8in; max height, 6ft 7in; max usable floor area, 191 sq ft; dimensions of largest door, 5ft 10in × 7ft (C-47); max seats, 28.

Fuel capacity: 670 Imp gal (805 US gal).

Performance: Cont cruising speed, 155kt (178 m.p.h.) at 10,000ft and 25,200lb; corres consumption 73.5 Imp gal/hr; balanced field length, max take-off weight, SL, ISA, 4,050ft; at SL, ISA+15°C, 4,400ft; landing distance from 50ft, 1,980ft; range A (max payload), 173 n.m. (199 st.m.); range B (max fuel), 1,780 n.m. (2,505 st.m.); corres payload, 8,600lb; corres cruise speed, 155kt (178 m.p.h.).

DC-4 The DC-4 has been to long-haul air transport what its stablemate the DC-3 was to the growth of the short-haul sector of the business. It is a four-engined unpressurized aeroplane capable of carrying 40-86 passengers on stage lengths of up to about 2,500 miles at a cruising speed of about 200 m.p.h.

The origins of the DC-4 go back to a requirement for a larger medium-haul transport issued by the four largest American carriers (American, United, TWA and Pan American) in mid-1935. Douglas produced a prototype—the DC-4E—to meet this requirement; this first flew on June 7, 1938, but did not prove satisfactory and was rejected by the airlines. Douglas thereupon started an entirely new and rather smaller project which became the DC-4. This flew for the first time on February 14, 1942. Orders for 61 were placed by American, Eastern and United early in 1940 but deliveries were diverted to military purposes and the type went into large-scale production and use as a military transport until the end of the War. Some 1,163 military DC-4s were delivered as C-54s before production was switched to a civil model at the end of the War, and 79 of this version were built before manufacture of the DC-4 was stopped in favour of the DC-6. The DC-4 cost between £140,000 and £160,000 in 1946/47. A typical used price today is about £80,000.

Powerplant: Four Pratt & Whitney R-2000-2SD-13Gs of 1,450 b.h.p. driving three-bladed Hamilton Standard Hydromatic 13ft 1in propellers.

Data appeared in *Flight*, November 20, 1959, page 606.

DC-6 The DC-4 design achieved its full potential as a civil transport only after the end of the Second World War when it appeared in a more powerful stretched and pressurized form known as the DC-6. The DC-6 carries 50-70 passengers on stage lengths of more than 2,500 miles at cruising speeds of up to 280 m.p.h. It is thus considerably faster than its predecessor because of the higher installed power (9,600 h.p. for take-off

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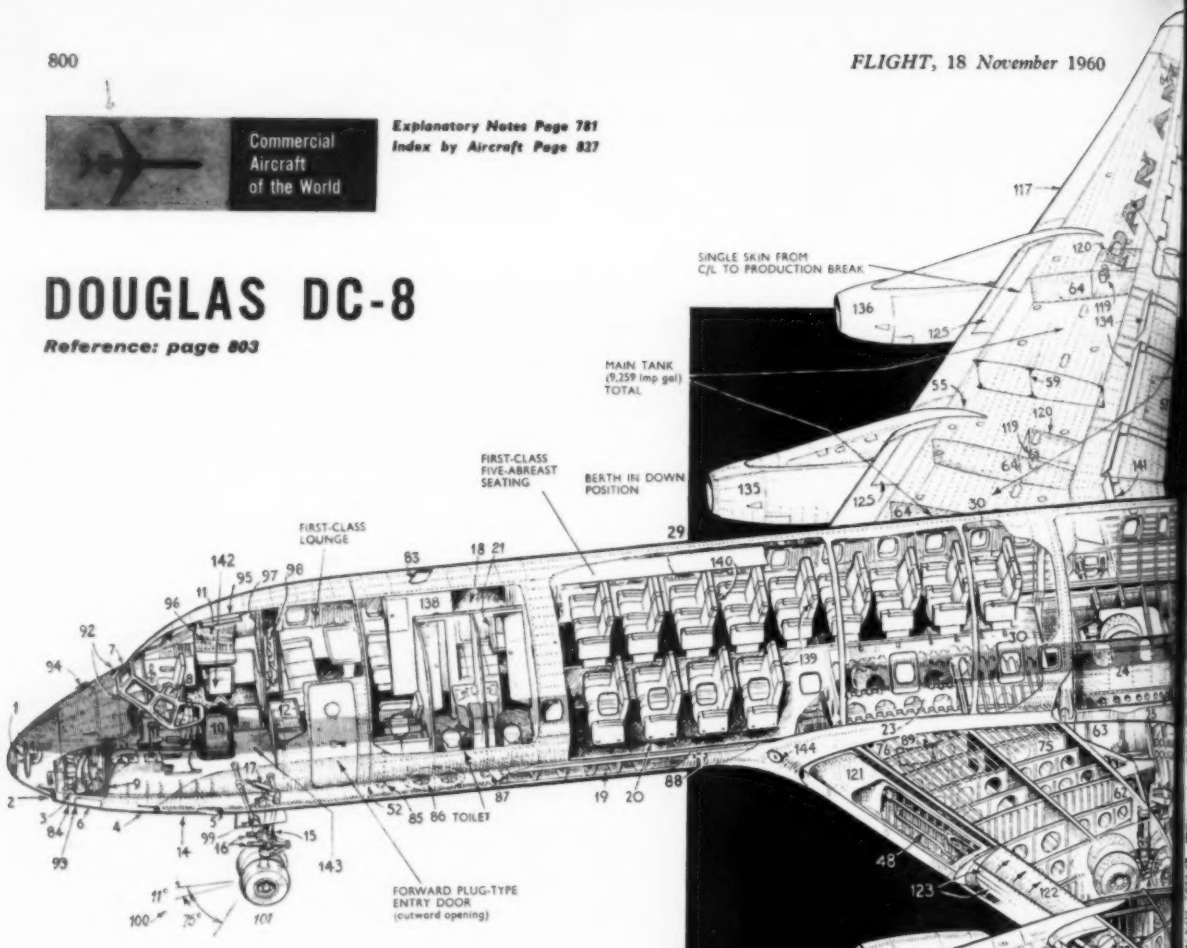
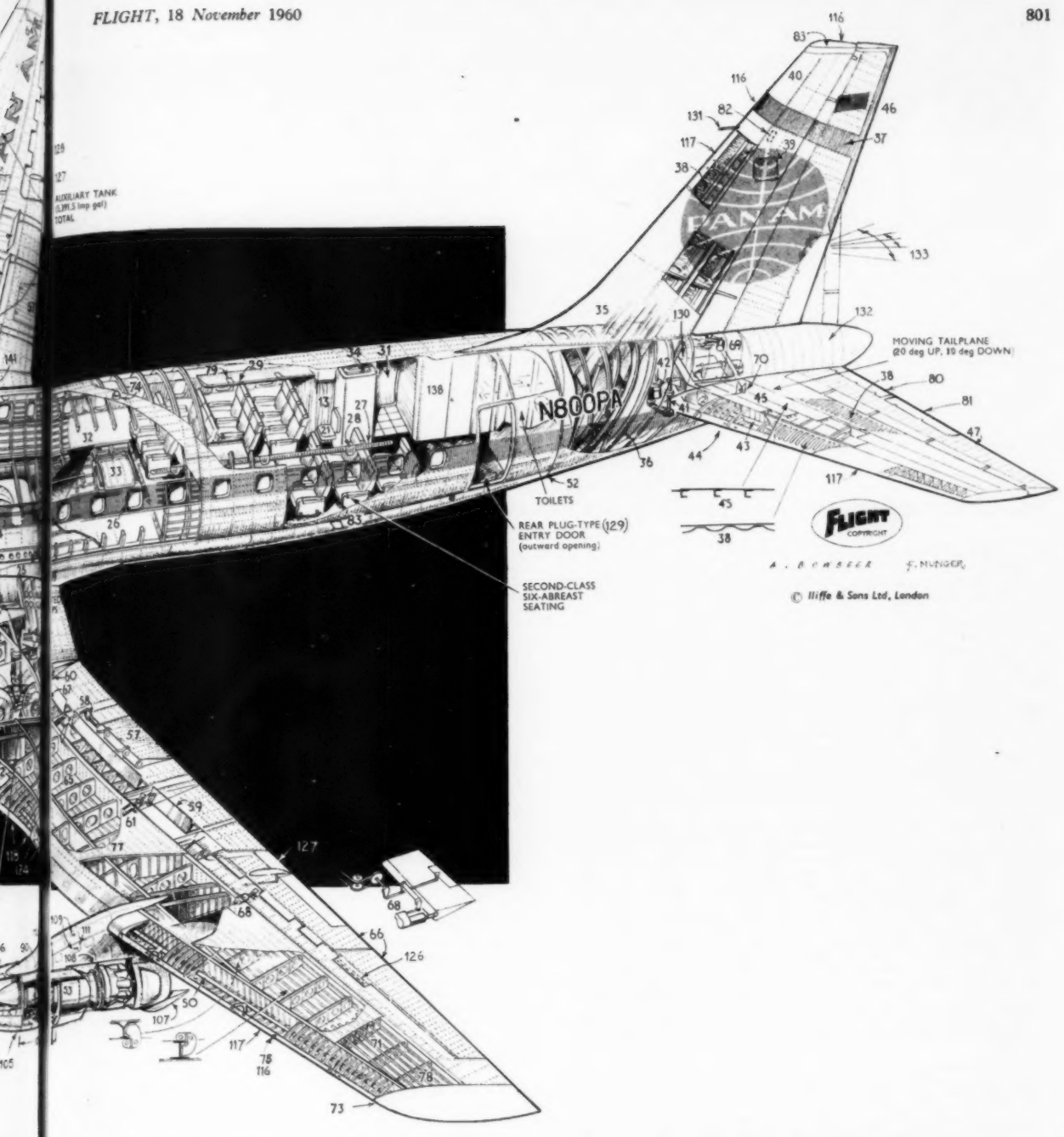
DOUGLAS DC-8

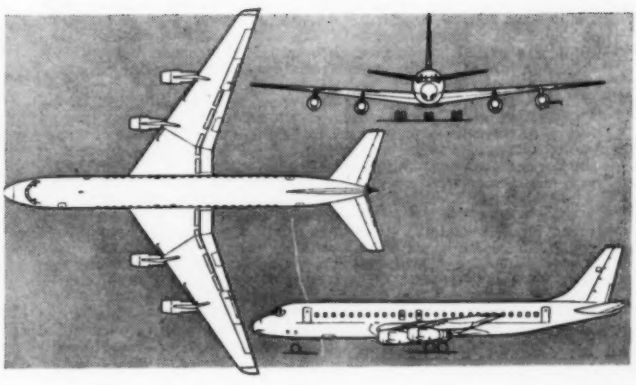
Reference: page 803


SINGLE SKIN FROM C/L TO PRODUCTION BREAK
MAIN TANK (9,259 Imp gal) TOTAL
FIRST-CLASS FIVE-ABREAST SEATING
BERTH IN DOWN POSITION
FIRST-CLASS LOUNGE
TOILET
FORWARD PLUG-TYPE ENTRY DOOR (outward opening)

1 AVQ 10 weather radar, hinged radome
2 Intake to cabin air system (both sides)
3 Four cabin-air turbo-compressors
4 Turbine exhaust
5 Heat-exchanger exhaust
6 Access door
7 Electrically heated multi-layer glass
8 Upper windows each side
9 Forward pressure bulkhead
10 Supernumerary seat
11 Engineer's panel
12 Radio racks (air cooled)
13 Coats
14 Pre-closing nosewheel-bay doors
15 DC-7-type nose-gear geometry
16 Steering cylinders
17 Retraction cylinder
18 Galley service doors
19 Under-floor hold (door starboard)
20 Wall-fixed seats
21 Attendant's seat
22 Centre joint butt strap
23 Centre-section tank (gravity feed all engines)
24 Centre keel member (5ft deep)
25 Mainwheel doors (normally closed after gear extension)
26 Windows (18½in x 15in)
27 Cabin air in, out at floor level
28 Passenger-address speaker
29 Hat racks
30 Emergency exits
31 Emergency doors
32 "Hotwall" panelling
33 Inward-opening freight door
34 Concealed lighting
35 Integral three-spar fin
36 Sloping frames
37 Dielectric structural isolation
38 Bonded inner skin
39 VOR aerial
40 HF aerials (1 and 2)
41 Tailplane screwjacks
42 Tailplane hydraulic and electric motors
43 Tail de-icing trunk
44 Retractable bumper
45 Integrally stiffened skin
46 Fully powered rudder
47 Manual elevators
48 Fuel system runs
49 De-icing duct (15th-stage air 232°C)
50 De-icing trunk
51 Hot air anti-icing
52 Production break
53 Pratt & Whitney JT4-9
54 Oil-cooler outlet
55 Inswept pylon tails
56 Intake to Sundstrand-drive oil coolers
57 Portion of flap hinged up to clear jet blast
58 Linkage to (57)
59 Three-spar fail-safe wing
60 Multiple scissor-links (inner to outer flap)
61 Flap-operating linkage
62 Main-leg subframe
63 Main-leg retraction jack
64 Tank bay end ribs (full depth)
65 Un-notched ribs (not full depth)
66 Divided powered ailerons
67 Bonded trailing-edge structure
68 Aileron power unit (emergency manual tab)
69 Rudder power unit
70 Tailplane hinge axis
71 Fuel-vent collector tank
72 Fire-suppression bottles (378 cu in CB and Freon)
73 Leading-edge venting
74 Anti-collision beacon
75 Skin thickness 0.250in
76 Skin thickness 0.190in
77 Skin thickness 0.156in
78 Upper skin 0.064in, lower 0.063in
79 Passenger-service panels (position variable with seat pitch)
80 Control tab
81 Geared tabs
82 HF aerial coupler and lightning arrester
83 VHF aerials (two)
84 Glide-slope aerial
85 DME aerial
86 ADF aerial
87 Transponder
88 Radio altimeter
89 ADF sense aerials (four)
90 Oil tank
91 Noise suppressors
92 Rain-shedding hot-air blast, 120lb/min (no wipers)
93 Ground air-conditioning
94 Pressure head
95 Engineer's diffused lighting
96 Preset auto-fuelling
97 Circuit breakers
98 Auto-generator circuit panel, aft equipment panel, crew oxygen
99 Landing/taxi lamp
100 Rudder pedal steering 11°, wheel steering 75°
101 Nose gear compression/extension controls: Reverse thrust on Nos. 1 and 4 engines Inboard spoilers, emergency decompression (800ft/min equivalent)
102 Engine earthing point
103 Forward and aft firewall terminating 175° zone
104 Vortex degenerator jets
105 Emergency starting access
106 Exhaust ejector, attenuator and reverser in retracted position
107 Exhaust ejector, attenuator and reverser in take-off (attenuator) position
108 Rails for 107
109 Pylon venting
110 Compressor bleed valve
111 Water filler valve
112 Compressor bleed outlet
113 Generator cooling air
114 Firex system access
115 Oil-filler access
Oil-cooler ground cooling ejectors
Engine-bay ground venting ejectors
Cabin-air turbo-compressor recirculation changeover



116 Continuous electrical anti-icing
117 Sequenced hot air (232°C) de-icing
118 Pressure refuelling points (two each side, 350gal/min)
119 Boost and feed pumps (cross-feed and emergency)
120 Feed tank (5min fuel)
121 Cell-type tank feeding centre tank
122 Leading-edge slots, open on more than 10° flap
123 Upper and lower doors open
124 Upper and lower doors closed
125 Slot (closed)
126 High- to low-speed aileron interconnecting torsion bar (1,100lb)
127 Manual trim-tab
128 Tab, locked when surface powered
129 Door seals serve as inwards relief
130 Empennage de-icing air exhausts to control-system zone
131 Flight-recorder pitot
132 Flight recorder stowage
133 Rudder high/low speed movement and pressure changeover at 10° flap
134 Three outboard spoilers controlled by port gear down (230kt)
135 Inboard engines, ground and in-flight reverse (12,000lb rating, 4,000lb reverse thrust)
136 Outboard engines, for ground reverse
137 Articulated main bogie, zero scuffing on 70° turn
138 Galley
139 Lights
140 Emergency oxygen, individual air, and individual lights in seat-backs
141 Inboard spoilers (see 101 and 134)
142 Engineer's station
143 Navigator's station
144 Fixed landing lamp



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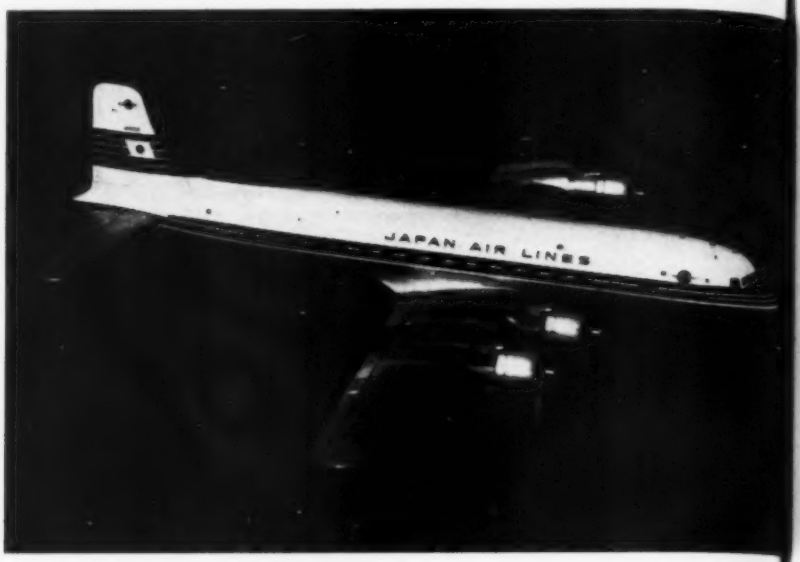

Douglas DC-6B of JAL (P&W R-2800-CB-17)

instead of 5,800 h.p.) and because it can operate at greater heights with its pressurized passenger accommodation. Apart from the more powerful engines and the strengthened structure which they require and which permits higher operating weights, the DC-6 differs from the DC-4 in having double-slotted flaps of increased efficiency which hold down the approach speed of the original domestic model to little more than that of the DC-4, in spite of the much increased landing-weight.

The DC-6 resulted from discussions with United Air Lines about an aeroplane for the US transcontinental routes. This was in 1944 while the War was still in progress; three prototypes were ordered by the USAAF as the XC-112A. The first flight took place on February 15, 1946. After the War, manufacture for the airlines got under way and deliveries to United started in 1947. Some 175 DC-6s were built and 160 are still in service with 23 airlines. The DC-6 cost between £210,000 and £230,000 in 1946/47 and its price rose to about £310,000 in 1951. Resale price today is about £175,000.

Powerplant: Four Pratt & Whitney R-2800-CB-16 of 2,400 b.h.p. driving three-bladed Hamilton Standard Hydromatic 13ft 1in propellers.

Data appeared in *Flight* for November 20, 1959 page 606.

DC-6A The success of the DC-6 suggested that further improvements in specific operating costs could be achieved with this same basic design by simply expanding its payload capacity. This was done with great success with the DC-6A, which appeared in 1949. Some were subsequently converted to passenger use and a mixed passenger/freighter version, the **DC-6C** was produced. Some 75 DC-6As and 6Cs were built for commercial operators of which 73 are still in service with 23 airlines. In addition, 167 military models of the DC-6A have been supplied to the US Services. The DC-6A cost between £460,000 and £480,000 in 1957-58. Used price today is about £296,000.

Powerplant: Four Pratt & Whitney R-2800-CB-17 of 2,500 b.h.p. driving three-bladed Hamilton Standard Hydromatic 13ft 6in propellers.

Dimensions: Span, 117ft 6in; length, 105ft 7in; height empty, 28ft 8in; wing area, 1,463 sq ft.

Weights: Max take-off 107,000lb; landing, 88,200lb; zero fuel, 83,200lb; capacity payload, 28,188lb; weight less fuel and payload, 57,000lb.

Payload accommodation: Cabin volume, 4,360 cu ft; baggage and freight volume, 539 cu ft; cabin length, 68ft; max width, 9ft 10½in; max height, 7ft 4in; max usable floor area, 596 sq ft; dimensions of largest door, 6ft 6½in × 10ft 4in; max seats, 100.

Fuel capacity: 4,600 Imp gal (5,520 US gal); water-meth, 33 Imp gal.

Performance: Typical cruising speed, 274kt (310 m.p.h.) at 22,500ft and 88,200lb; corres consumption, 350 Imp gal/hr; balanced field length, max take-off weight, SL, ISA, 6,150ft; at 5,000ft, ISA, 5,420ft at 90,000lb; landing distance from 50ft, 3,100ft; range A (max payload), 2,540 n.m. (2,920 st.m.); range B (max fuel), 4,100 n.m. (4,720 st.m.); corres payload, 17,580lb; corres cruise speed, 230kt (265 m.p.h.).

DC-6B The DC-6B passenger airliner was the logical outcome of the DC-6A freighter. It had a fuselage lengthened by another 13in and dispensed with the various special freighting provisions of its predecessor. It will accommodate between 60 and 100 passengers depending on the layout. The first DC-6B flew on February 2, 1951, and the type went into service with Western Air Lines in April of the same year. Flown by American Airlines on the prestige "coast-to-coast" routes, the DC-6B was for a time the fastest equipment in use. However, it was not so much for its performance, which does not differ greatly from that of the DC-6, as for its excellent economics that the DC-6B was to gain a great reputation, remain longer in production and be built in greater numbers than any other of the later developments of the DC-4. It is probable that lower seat-mile costs have, in fact, been achieved with DC-6Bs than with any other piston-engined equipment. A total of 287 DC-6Bs were produced and production was not completed until late in 1958, when manufacture of the DC-8 jet transport was getting under way; 271 are still in service with 29 airlines. The DC-6B cost about £500,000 in 1958 and resale price today is about £227,000.

Powerplant: As DC-6A.

Dimensions: As DC-6A, except: length, 106ft 8in.

Weights: As DC-6A, except: capacity payload, 19,200lb; weight less fuel and payload, 64,000lb.

Payload accommodation: As DC-6A.

Fuel capacity: As DC-6A.

Performance: Typical cruising speed, 274kt (315 m.p.h.) at 22,500ft and 88,200lb; corres consumption, 350 Imp gal/hr; balanced field length, max take-off weight, SL, ISA, 6,150ft; at 5,000ft, ISA, 5,420ft at 90,000lb; landing distance from 50ft, 3,100ft; range A (max payload), 2,650 n.m. (3,050 st.m.); range B (max fuel), 4,100 n.m. (4,720 st.m.); corres payload, 14,000lb; corres cruise speed, 230kt (265 m.p.h.).

DC-7 This further development of the DC-4 family owed its origins to the competitive pressures on the domestic routes within the United States and particularly to the struggle between the airline "giants," American, United and TWA, on the transcontinental routes. In 1950 TWA ordered from Lockheed a stretched version of the Constellation, the L.1049C with the new powerful Wright Turbo-Compound engine. This aircraft was obviously going to outpace the DC-6B then in service and would, for the first time, offer non-stop coast-to-coast capability. American Airlines accordingly ordered from Douglas an equivalent development of the DC-6B using the same compound engine, and thus became the DC-7.

Although fast, the DC-7 is perhaps an example of a transport aeroplane which has been developed beyond the point of diminishing returns. Although the type served its purpose admirably—indeed, 107 were built—its economic characteristics are inferior to those of the DC-6B. The cost was about £570,000; price today is very much lower. *Flight* description: July 30, 1954.

Powerplant: Four Wright R-3350-988 TC-18 DA-4 Turbo-Compounds of 3,250 b.h.p. driving four-bladed Hamilton Standard Hydromatic 13ft 6in propellers.

Dimensions: Span, 117ft 6in; length, 108ft 11in; height empty, 28ft 7in; wing area, 1,463 sq ft.

Weights: Max take-off, 122,200lb; landing, 97,000lb; zero fuel, 91,000lb; capacity payload, 20,000lb.

Payload accommodation: Cabin volume, 4,647 cu ft; baggage and freight volume, 983 cu ft; cabin length, 84ft; max width, 9ft 10½in; max height, 7ft 4in; max usable floor area, 625 sq ft; dimensions of largest door, 3ft × 6ft; max seats, 100.

Fuel capacity: 4,600 Imp gal (5,520 US gal).

Performance: Typical cruising speed, 312kt (358 m.p.h.) at 24,200ft and 105,000lb; corres consumption, 420 Imp gal/hr; balanced field length, max take-off weight, SL, ISA, 6,060ft; at 5,000ft, ISA, 7,320ft at 118,800lb; landing distance from 50ft, 5,520ft at 95,000lb; range B (max fuel), 3,770 n.m. (4,430 st.m.).

DC-7B The DC-7B is similar to the DC-7 but is fitted with extra tankage for long-haul overwater operation and is cleared for higher weights. The DC-7B first flew on April 25,1955, and entered service with Pan American less than a month later. A total of 110 DC-7Bs were built. The price of the DC-7B increased from about £680,000 in 1955 to about £820,000 in 1957. Resale price today is very low.

Powerplant: As DC-7.

Dimensions: As DC-7.

Weights: Max take-off, 126,000lb; landing, 102,000lb; zero fuel, 96,000lb; capacity payload, 21,516lb; weight less fuel and payload, 74,000lb.

Payload accommodation: As DC-7.

Fuel capacity: 5,380 Imp gal (6,460 US gal).

Performance: Typical cruising speed, 313kt (360 m.p.h.) at 24,300ft and 102,000lb; corres consumption, 420 Imp gal/hr; balanced field

Douglas DC-8-30 of UAT (P & W JT4A-3 turbojets)

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length, max take-off weight, SL, ISA, 6,350ft; at 5,000ft, ISA, 7,650ft at 122,600lb; landing distance from 50ft, 5,950ft; range A (max payload), 2,850 n.m. (3,280 st.m.); range B (max fuel), 4,275 n.m. (4,910 st.m.); corres payload, 11,600lb; corres cruise speed, 248kt (285 m.p.h.).

DC-7C The DC-7 and DC-7B were criticized in service for their relatively high interior noise and vibration levels, which resulted from the 3,250 h.p. Wright compound engines in an airframe designed originally (as the DC-4) for units of 1,450 h.p. This led Pan American to discuss with Douglas ways of improving the design while stretching it still further to provide non-stop North Atlantic range. Ability to fly the North Atlantic routes non-stop on a high percentage of occasions in the critical westbound direction against the strong prevailing winds had long been a major objective of all the competing Atlantic carriers, so that the DC-7C marked an important step forward both operationally and commercially. Douglas developed the DC-7C from the DC-7B in the short space of about a year, extending the wing by the insertion of an additional 10ft of centre section. Altogether 121 DC-7Cs were sold. This was the last stretch of the famous DC-4/7 series. The DC-7C finally went out of production late in 1958 at the same time as the DC-6B. The DC-7C cost about £800,000 in 1956 and increased to about £930,000 by 1958. The price today is very much lower. *Flight* description: July 6, 1956.

Powerplant: Four Wright R-3350-988 TC-18 EA-4 Turbo-Compounds of 3,400 b.h.p. driving four-bladed Hamilton Standard 14ft propellers.

Dimensions: Span, 127ft 6in; length, 112ft 3in; height empty, 31ft 10in; wing area, 1,637 sq ft.

Weights: Max take-off, 143,000lb; landing, 110,000lb; zero fuel, 101,500lb; capacity payload, 23,350lb; weight less fuel and payload, 82,000lb.

Payload accommodation: Cabin volume, 4,863 cu ft; baggage and freight volume, 1,149 cu ft; cabin length, 87ft 4in; max width, 9ft 10½in; max height, 7ft ¾in; max usable floor area, 654 sq ft; dimensions of largest door, 3ft × 6ft; max seats, 99.

Fuel capacity: 6,515 Imp gal (7,810 US gal).

Performance: Typical cruising speed, 308kt (354 m.p.h.) at 23,500ft and 110,000lb; corres consumption, 420 Imp gal/hr; balanced field length, max take-off weight, SL, ISA, 6,400ft; at 5,000ft, ISA, 7,690ft at 136,800lb; landing distance from 50ft, 5,450ft at 109,000lb; range A (max payload), 4,000 n.m. (4,600 st.m.); range B (max fuel), 4,900 n.m. (5,630 st.m.); corres payload, 15,300lb; corres cruise speed, 238kt.

DC-7F Douglas are converting to special order on a production line at Santa Monica 33 DC-7 series aircraft for all-cargo use, designation becoming DC-7F ("Speedfreighter") after fitting enlarged fore and aft cargo doors, heavier floor and floor beam structure, lining inside fuselage walls with glass-fibre laminate, and removing all windows. Cost of conversion averages about £115,000 per aircraft. The first DC-7F went into service with American Airlines in September 1959.

Conversion orders have been placed by American Airlines, fifteen DC-7B; United, six DC-7B; Panagra, one DC-7B; KLM, two DC-7C; Alitalia, two DC-7C; BOAC, two DC-7C; JAL, two DC-7C; and Riddle, three DC-7C (plus seven more on option).

A special version with pallets-and-rollers cargo loading is available. Typical data for a DC-7B conversion are as follows:—

Weights: Max take-off, 126,000lb; max landing, 106,800lb; max zero fuel, 100,800lb; capacity payload, 34,600lb (38,000lb for the DC-7C conversion).

Payload accommodation: Max internal width, 9ft 10½in; volume, 5,000-plus cu ft; dimensions of largest door, 6ft 6in × 10ft 4in.

DC-8 Latest addition to the world's most respected family of airliners was announced in 1955, first flown on May 30, 1958, certificated (JT3 domestic model) on August 31, 1959, and introduced into service simultaneously by United Air Lines and Delta on September 18, 1959. A total of 145 have been ordered by 20 airlines.

Like its rival the Boeing 707, the DC-8 is offered a variety of versions; there are two domestic (series 10 and 20) and three international models (series 30, 40, 50), with different tankages and engines —all versions (unlike the 707) being dimensionally identical.

The domestic DC-8s are powered either by Pratt & Whitney JT3C or JT4A engines; the international versions have JT4A or Rolls-Royce Conways. Two operators (KLM and Iberia) have specified P & W JT3D turbofans. The order book and delivery dates as this issue went to press accounted for 156 aircraft, of which about 100 had been delivered:—

Aeronaves, one (delivered October 1960); **Alitalia,** eight -40 (from April 1960); **CPAL,** four -40; **Delta,** six—two -10, four -20 (from July 1959); **Eastern,** sixteen -20 (from January 1960); **Iberia,** three -50; **JAL,** five -30 (from July 1960); **KLM,** twelve—seven -30, five -50 (from March 1960); **National,** three -20 (from February 1960); **Northwest,** five -30; **Pan American,** seventeen -30 (from February 1960); **Panagra,** four -30 (April 1960); **Panair do Brasil,** two -30; **Philippine,** two; **SAS,** seven -30 (from March 1960); **Swissair,** three -30 (from April 1960); **TCA,** eleven -40 (from February 1960); **TAI,** three -30 (from July 1960); **United,** forty (from June 1959)—twenty-two -10, eighteen -20; **UAT,** two -30 (from June 1960).

Cutaway drawing, pages 800 and 801. *Flight* references: July 25, 1958; November 1, 1957; July 6, 1956. Basic price (JT4 domestic): £1,950,000.

To improve range, speed and payload, Douglas have a modification programme for a sharper leading-edge glove to be fitted to the full span of the wing (already increased by 2ft 8in early in the production programme, together with the addition of fixed valve-slots to reduce stalling speed and take-off run). The leading-edge glove will extend chord by about four per cent and wing area will go up to 2,868 sq ft.

The modification will be incorporated from DC-8 No 148. Douglas claims it will improve specific range by eight per cent, Mach number by 0.02, and that it will reduce cost per ton-mile by more than two per cent. It will, it is said, increase payload on long flights by 7,000lb. No account is taken of these improvements in the data below.

DC-8-10 This is the domestic JT3C-6 model:—

Powerplant: Four Pratt & Whitney JT3C-6 turbojets of 13,500lb static thrust each with water injection.

Dimensions: Span, 142ft 5in; length, 150ft 6in; height empty, 42ft 4in; wing area, 2,773 sq ft.

Weights: Max. take-off, 273,000lb; landing, 193,000lb; zero fuel, 162,400lb; capacity payload, 34,000lb; weight less fuel and payload, 121,000lb.

Payload accommodation: Cabin volume, 7,945 cu ft; baggage and freight volume, 1,390 cu ft; cabin length, 103ft; max width, 11ft 8in; max height, 6ft 8in; max usable floor area, 1,100 sq ft; dimensions of largest door, 32in × 72in; max seats, 173.

Fuel capacity: 14,600 Imp gal (17,600 US gal).

Performance: Max cruising speed cruise thrust at 220,000lb weight, 482kt (555 m.p.h.); FAA take-off field length at max weight, 9,330ft; FAA landing field length at max landing weight, 6,400ft at 129kt (148 m.p.h.); max still-air range, 3,580 n.m. (4,120 st.m.).

DC-8-20 This is the domestic JT4A-3 model:—

Powerplant: Four Pratt & Whitney JT4A-3 turbojets of 15,800lb static thrust. No water injection.

Dimensions: As above.

Weights: Max take-off, 276,000lb; landing, 193,000lb; zero fuel, 162,500lb; capacity payload, 34,000lb; weight less fuel and payload, 123,750lb.

Payload accommodation: As above.

Fuel capacity: As above.

Performance: Max cruise thrust cruising speed at 220,000lb weight, 511kt (588 m.p.h.); FAA take-off field length at max weight, 8,200ft; FAA landing field length at max landing weight, 6,400ft at 129kt (148 m.p.h.); max still-air range, 3,820 n.m. (4,280 st.m.).

DC-8-30 This is the intercontinental JT4A-3 model:—

Powerplant: Four Pratt & Whitney JT4A-3 turbojets of 15,800lb s.t.

Dimensions: As above.

Weights: Max take-off 310,000lb landing, 199,500lb; zero fuel, 174,600lb; capacity payload, 36,500lb; weight less fuel and payload, 126,072lb.

Payload accommodation: As above.

Fuel capacity: 19,150 Imp gal (23,080 US gal).

Performance: Max cruise thrust cruising speed at 220,000lb weight, 511kt (588 m.p.h.); FAA take-off field length at max weight, 10,800ft; FAA landing field length at max landing weight, 6,590ft at 130kt (150 m.p.h.); max still-air range, 4,610 n.m. (5,300 st.m.).

DC-8-40 This is the intercontinental Rolls-Royce Conway model:—

Powerplant: Four Rolls-Royce Conway RCo.12 turbojets of 17,800lb static thrust. No water injection.

Dimensions: As above.

Weights: Max take-off, 310,000lb; landing, 199,500lb; zero fuel, 174,600lb; capacity payload, 36,500lb; weight less fuel and payload, 124,370lb.

Payload accommodation: As above.

Fuel capacity: As for DC-8-30.

Performance: Max cruise thrust cruising speed at 220,000lb weight, 515kt (593 m.p.h.); FAA take-off field length at max weight, 9,750ft; FAA landing field length at max landing weight, 6,590ft, at 130kt (150 m.p.h.); max still-air range, 4,720 n.m. (5,430 st.m.).

DC-8-50 This is the intercontinental turbofan JT3D model:—

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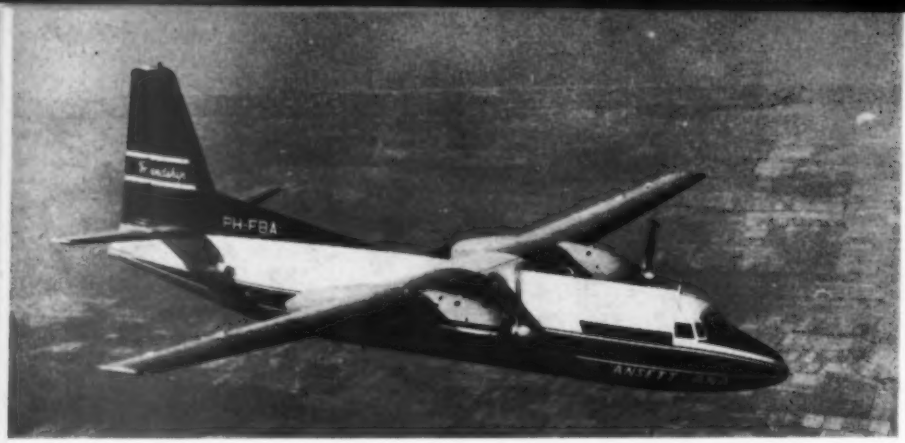

Fokker F.27 Friendship of Ansett-ANA (Rolls-Royce Dart RDa.7)

Powerplant: Four Pratt & Whitney JT3D-3 turbofans of 18,000lb static thrust. No water injection.

Dimensions: As above.

Weights: Max take-off, 310,000lb; landing, 199,500lb; zero fuel, 168,500lb; capacity payload, 36,500lb; weight less fuel and payload, 124,529lb.

Payload accommodation: As above.

Fuel capacity: As for DC-8-40.

Performance: Max cruise thrust cruising speed at 220,000lb weight, 509kt (585 m.p.h.); FAA take-off field length at max weight, 9,750ft; FAA landing field length at max landing weight, 6,590ft at 130kt (150 m.p.h.); max still-air range, 5,150 n.m. (5,930 st.m.).

DC-8A This is an unofficial designation of a swing-tail all-cargo project, one of a number that Douglas has prepared as candidates for the big MATS strategic freighter contract soon to be placed by the USAF. The following facts and figures have been quoted by Douglas: power-plant, P & W JT3D-9 turbofan (wet) or Rolls-Royce RCo.42; max take-off weight, 350,000lb; max landing weight, 273,500lb; max zero fuel, 247,500lb; max fuel (at 6.7lb/gal), 154,540lb; max revenue payload (palletized), 111,941lb.

Douglas say that a prototype DC-8A (JT3D) could be flown early in 1962. Orders of between 5 and 10 would be needed to begin production; unit cost has been reported as about £2½m.

FAIRCHILD *Fairchild Aircraft and Missiles Division, Fairchild Engine and Airplane Corporation, Hagerstown, Maryland, USA.*

F-27 Construction of the F-27 by Fairchild in America followed from a long-standing association of Fokker and Fairchild. An agreement was concluded in April 1956 and work began two months later, and the first Hagerstown-built aircraft flew on April 12, 1958.

Three versions are offered by the US manufacturer: a local service airliner with up to 44 seats, an executive aircraft with provision for 1,380 Imp gal fuel, and a cargo aircraft (the **F-27B**) with a strengthened floor and a larger forward door. Most of Fairchild's airline customers—which total 13—have specified the higher-powered Rolls-Royce Darts, but both RDa.6 and RDa.7 versions are on offer. The standard version is now the RDa.7-equipped F-27A. US-built aircraft include some American equipment and provision is made for nose radar. First delivery was to West Coast Airlines on June 22, 1958, and this airline inaugurated the world's first Friendship services on September 28, 1958. Basic price of the RDa.6 F-27 is about £239,000. Order book: see *Flight*, January 8, 1960 Some 83 F-27s have now been sold.

Powerplant: As Fokker F.27.*

Dimensions: As Fokker F.27 except length, 77ft 2in.

Weights: Max take-off, 37,500lb; max landing, 36,000lb; zero fuel, 34,000lb; capacity payload, 10,193lb; weight less fuel and payload 23,807lb.

Payload accommodation: Cabin volume (less flight deck), 2,118 cu ft; baggage and freight volume, 180 cu ft; cabin length (total), 47ft 4in; max usable floor area (less flight deck), 225.5 sq ft; max seats, 44. Remainder as Fokker F.27.

Fuel capacity: As Fokker F.27.

Performance: Typical cruising speed, 260kt (300 m.p.h.) at 20,000ft and 33,000lb; corres specific fuel consumption, 0.632lb/s.h.p./hr; SR422 take-off distance, 2,750ft; actual landing distance from 50ft, 2,195ft; range A (max payload), 350 n.m. (404 st.m.); range B (max fuel), 2,100 n.m. (2,412 st.m.); corres payload, 2 passengers; corres cruising speed, 208kt (240 m.p.h.).

*RDa.7 version.

FOKKER *Royal Netherlands Aircraft Factories, Fokker, Schiphol-Z, Amsterdam, Holland.*

F.27 Friendship Fokker's DC-3 replacement is another type that, since this issue was last compiled, has blossomed out into a host of new versions. In all, there are now nine: F.27 Friendship airliner with Rolls-Royce RDa.6 engines: the same with RDa.7s; F.27 Friendship-de-luxe (RDa.6 or RDa.7); F.27 Freightship (RDa.6 or RDa.7); F.27M Troopship (RDa.6 or RDa.7); F.27S short field version (RDa.6 or RDa.7); F.27 "Long Friendship" stretched version with RDa.7s or RDa.10s; F.27 high-density Friendship; and F.27 high-density Long Friendship. From an airline point of view, the most important new version is probably the Long Friendship, which has been offered to Eastern by Fairchild in America and which—in one form or another—will be built in Holland. The fuselage is stretched by 8ft 3in to accommodate up to 64 passengers; direct costs for the high-density version are 0.89 pence per seat mile. The "STOL" F.27S is primarily a military variant, although it has interesting commercial possibilities as it embodies rear-end loading, double slotted flaps, a v.i. tailplane, 37lb/sq in tyres and has a take-off length of 660ft at 37,500lb. Max payload is 12,220lb. This and other new variants were described in *Flight*, July 15, 1960; see also November 20, 1959.

Fokker have now sold 85 aircraft and have options on another 19. Airline customers are: **Aer Lingus**, 7 (RDa.6); **All-Nippon**, 3 (RDa.7); **Australian** airlines, 9 (RDa.7); **East-West**, 1 (RDa.6); **IAC**, 5 (RDa.6); **KLM**, 2 (RDa.6); **Lufttransport Unternehmen**, 1 (RDa.6); **Mac Robertson Miller**, 1 (RDa.7); **NZNAC**, 8 (RDa.6); **PIA**, 5 (RDa.7, 1 Freightship); **PAL**, 2 (RDa.6); **Sudan Airways**, 3 (RDa.7); **TAA**, 10 (RDa.6 and RDa.7); and **THY**, 5 (RDa.6). Basic price of the RDa.6-powered F.27 is £229,000; of the RDa.7 200-series aircraft, £250,000; and of the RDa.6-powered Freightship £245,000.

Fokker F.27 Series 100

Powerplant: Two Rolls-Royce Dart 511 RDa.6 turboprops of 1,600 s.h.p. driving 12ft diameter Rotol 4-bladed propellers.

Dimensions: Span, 92ft 2in; length, 74ft 9in; height empty, 22ft 6in; wing area, 756 sq ft.

Weights: Max take-off, 37,500lb; max landing, 35,700lb; zero fuel, 35,200lb; capacity payload, 12,623lb; weight less fuel and payload, 22,175lb (40 seats).

Payload accommodation: Gross cabin volume, 2,130 cu ft; baggage and freight volume, 225 cu ft; cabin length, 47ft 6in; max internal width, 8ft 4in; max height, 6ft 8in; max usable floor area (less flight deck), 312 sq ft; dimension of largest door, 47in × 41in; max seats 40 at 35.4in pitch (normal) or 52 at 30in pitch high density.

Fuel capacity: 1,137 Imp gal (1,367 US gal).

Water-methanol capacity: 66 Imp gal (79 US gal).

Performance: Typical cruising speed, 236kt (271 m.p.h.) at 17,000ft and 35,000lb; corres fuel consumption, 0.172 n.m./lb; balanced field length, max weight, SL, ISA, 5,760ft; ISA+15°C, 5,100ft; range A (max payload), 395 n.m. (455 st.m.); range B (max fuel, 1,620 n.m. (1,865 st.m.); corres payload, 5,525lb; V_{NE}, 259kt (298 m.p.h.) IAS; V_{NO}, 227kt (261 m.p.h.) IAS; V_{SO}, 76 m.p.h. RAS.

Fokker F.27 Series 200

Powerplant: Two Rolls-Royce Dart 528 RDa.7 turboprops of 1,910 s.h.p. each driving 11.5ft diameter Rotol 4-bladed propellers.

Dimensions: As 100 series.

Weights: As 100 series except zero fuel, 35,100; capacity payload, 12,580lb; weight less fuel and payload, 23,110lb.

Payload accommodation: As 100 series.

Grumman Gulfstream (Rolls-Royce Dart RDa.7)

Handley Page Hermes 4 of Silver City (Bristol Hercules 763)

Fuel capacity and water-methanol capacity: As 100 series.
Performance: Typical cruising speed, 265kt (305 m.p.h.) TAS at 20,000ft and 35,000lb; corres fuel consumption, 0.1805 n.m./lb; balanced field length, max weight, SL, ISA, 3,450ft; at ISA+15°C, 3,900ft; at 5,000ft, ISA, 5,150ft; range A (max payload), 267 n.m. (307 st.m.); range B (max fuel), 1,530 n.m. (1,761 st.m.); corres payload, 5,187lb; V_{NE}, 259kt (298 m.p.h.) IAS; V_{NO}, 227kt (261 m.p.h.) IAS; V_{SO}, 66kt (76 m.p.h.) RAS.

Fokker F.27 Series 300 (Freightship)
Powerplant: Two Rolls-Royce Dart 511 RDa.6 turboprops of 1,600 s.h.p. driving Rotol 12ft diameter 4-blade propellers.
Dimensions: As 100 series.
Weights: As 100 series except capacity payload, 13,400lb; weight less fuel and payload, 21,800lb;
Payload accommodation: As 100 series except dimensions of largest door, 91.5in × 70in.
Fuel and water-methanol capacity: As 100 series.
Performance: As 100 series.

Fokker F.27 "Long Friendship"
Powerplant: Two Rolls-Royce Dart RDa.7/2 or RDa.10 turboprops.
Dimensions: As 100 series except length, 84ft ½in and height, about 28ft.
Weights: Max take-off, 42,000lb; max landing, 41,000lb
Payload accommodation: Cabin volume, 2,480 cu ft; max usable floor area (less flight deck) 360 sq ft; max seats, 48 at 35½in pitch or 60-64 at 30in pitch.
Performance: Range with max payload, plus reserves, 48-seater, RDa.7/2, 655 n.m. (755 st.m.); RDa.10, 603 n.m. (695 st.m.); 60-seater, RDa.7/2, 338 n.m. (390 st.m.); RDa.10, 286 n.m. (330 st.m.).

GRUMMAN *Grumman Aircraft Engineering Corp, Bethpage, Long Island, New York, USA.*

Grumman Amphibians The Grumman G-21 **Goose** six-seater airline and executive amphibian first flew in June, 1937, powered by two 450 h.p. Pratt & Whitney R-985 Wasp Juniors, and a total of 345 were built. There are 30 still in service with 12 operators, mostly in Alaska, Canada and the Caribbean. The Goose was followed by the smaller, five-seater G-44 **Widgeon**, first flown in July, 1940, and powered by two 200 h.p. Ranger 6-440-C5 engines. About half a dozen of the 286 Widgeons built remain in airline service. The G-73 **Mallard**, first flown in 1946, is rather larger; it seats up to 10 and is powered by two 600 h.h.p. Pratt & Whitney R-1340-S3H-1 Wasps. Only two of the 61 Mallards built are in airline service, with Pacific Western Airlines. The SA-16A-GR **Albatross** is much larger, having over twice the gross weight and engine power and a 13ft 4in greater wing span. Albatross production (over 300 have been built) has been entirely for military use, but three ex-USAF SA-16As are used by Transocean Airlines. Also in military use is the SA-16B, a variant with a larger wing span. *Flight* reference to the G-21 Goose: November 20, 1959.

G-159 Gulfstream The twin-Dart Gulfstream is Grumman's contender for the American "heavy twin" executive market. The prototype made its first flight on August 14, 1958, and the company has now received orders for some 56 aircraft. Up to 12 passengers can be accommodated, or 19 in a high-density layout. Current basic price is about $1m.
Flight reference: April 3, 1959.
Powerplant: Two Rolls-Royce RDa.7/2 Dart 529 turboprops of 2,190 e.h.p. each driving 11ft 6in diameter Rotol four-bladed propellers.
Dimensions: Span, 78ft 4in; length, 63ft 8in; height, 22ft 9in; wing area, 615 sq ft.
Weights: Max take-off, 35,100lb; landing, 33,600lb; zero fuel, 26,170lb; capacity payload, 4,270lb; weight less fuel and payload, 21,909lb.
Payload accommodation: Cabin volume, 1,040 cu ft; baggage and freight volume, 100 cu ft; cabin length, 33ft; max width, 7ft 4in; max height 6ft 1in; usable floor area, 177 sq ft; dimensions of largest door, 63in × 36in; max seats, 19 at 35in pitch.
Fuel capacity: 1,291 Imp gal (1,550 US gal), and 600lb water-methanol.
Performance: Cont cruising speed, 302kt (348 m.p.h.) at 25,000ft and 27,500lb, with a fuel consumption of 1,400lb/hr, balanced field length, max take-off weight, sea level, ISA, 4,480ft; sea level, ISA+15°C, 4,810ft; at 5.000ft, ISA, 5,700ft; landing distance from 50ft, 2,680ft; range A (max payload), 1,059 n.m. (1,218 st.m.); range B (max fuel), 2,448 n.m. (2,818 st.m.); corres payload, 2,740lb; V_{NE}, 310kt (357 m.p.h.) IAS; V_{NO}, 290kt (334 m.p.h.) IAS; V_{SO}, 75½kt (87 m.p.h.) EAS.

HAMBURGER FLUGZEUGBAU *Postschliessfach 11 524, Hamburg-Finkenwerder, Kreetslag 10.*

H.F.B. 314 This is a 70-78 seat short-medium range jet transport in the D.H.121/Boeing 727/Caravelle 14 class, powered by two Rolls-Royce RB 141/11 turbojets. The West German Government is reported to have been advised by Lufthansa that the project is worthy of government backing. In October 1960 the West German Economics Minister said in Parliament that the Government is ready to negotiate with the firm with regard to financing.
Powerplant: Two Rolls-Royce RB.141/11 (or General Electric CJ-805-23, or two P. & W. JT3D-3).
Dimensions: Span, 93ft; length, 119ft; height, 26ft 10in; wing area, 1,230 sq ft; sweepback, 35°.
Weights: Max take-off, 89,100lb; max landing, 83,800lb; zero fuel weight, 70,600lb; capacity payload, 23,600lb; weight less fuel and payload, 46,000lb.
Payload accommodation: Cabin volume, 3,460 cu ft; baggage and freight volume, 880 cu ft; cabin length, 72ft 10in; max internal width, 9ft 2in; max height, 6ft 10in; max usable floor area, 577 sq ft; dimensions of largest door(s), 71in × 36in; max number of seats, 78; corres. pitch, 34in.
Fuel capacity: 4,530 Imp gal (5,450 US gal).
Performance: Opt. cost cruising speed at 36,000ft and 77,000lb, 513kt (591 m.p.h.); corres. fuel consumption, 880 Imp gal/hr; range A (max payload), 1,320 n.m. (1,520 st.m.); range B (max. fuel), 2,290 n.m. (2,640 st.m.), corres. payload, 8,800lb; cruise Mach number, 0.815; V_{NE}, 425kt (489 m.p.h.) IAS; V_{NO}, 370kt (426 m.p.h.) IAS; V_{SO}, 106kt (122 m.p.h.) EAS.

HANDLEY PAGE *Cricklewood, London NW2.*

H.P.81 Hermes 4 Developed from the H.P.68 Hermes 1 prototype of 1945, through the experimental Hermes 2, the Hermes 4 was the first British four-engined airliner of post-war design to enter service with BOAC. It was used extensively on the corporation's African routes from March 1950, and a total of 25 were built, all for BOAC. This fleet was sold to various British independents, and a total of 15 are now operated by Silver City, Air Safaris, Falcon and Skyways.
Hermes have been up for sale at £10,000 each.
Powerplant: Four Bristol Hercules 763 of 2,100 b.h.p. each driving 13ft de Havilland four-bladed propellers.
Dimensions: Span, 113ft; length, 96ft 10in; height, 30ft; gross wing area, 1,408 sq ft.
Weights: Max take-off, 86,000lb; landing, 75,000lb; capacity payload, 17,000lb; empty, 51,655lb.
Payload accommodation: Baggage and freight volume, 452 cu ft; cabin length, 44ft 5in; max width, 10ft 3in; max seats, 74.
Fuel capacity: 3,206 Imp gal.
Performance: Max weak mixture cruising speed, 232kt (266 m.p.h.) at 20,000ft; take-off distance to 50ft, 4,086ft; landing distance from 50ft, 3,375ft; payload for max range, 6,349lb; a 14,400lb payload can be carried 1,740 n.m. (2,000 st.m.) at 240kt (276 m.p.h.) at 20,000ft.

Marathon Designed by Miles Aircraft, the Marathon prototype made its first flight on May 19, 1946, and production was undertaken by Handley Page (Reading) Ltd, which took over Miles Aircraft in June 1948. A total of 40 Marathons were built, of which 29 were operated by the RAF as navigational trainers. First commercial operator of Marathons was West African Airways Corporation, followed by Union of Burma Airways and Far East Airlines (now part of All Nippon Airways). The two Japanese Marathons have now been grounded, and Derby Aviation, with three aircraft, is the only operator of this type.
Powerplant: Four D.H. Gipsy Queen 70 Mk 3 (Marathon 1) or 70 Mk 4 (Marathon 1A) engines of 340 b.h.p. each driving 7ft 6in de Havilland Hydromatic three-bladed propellers.
Data appeared in *Flight* for November 20, 1959, page 609.

H.P.R.3 Herald Series 100 and 200 Designed as a private-venture replacement for the DC-3, the Herald prototype, powered by four 825 b.h.p. (max take-off) Alvis Leonides Major 701 piston engines, made its first flight on August 25, 1955; the second prototype took to the air just over a year later. Increasingly wide acceptance of the Rolls-Royce Dart led to the piston-engined version eventually being abandoned in favour of the Dart Herald, announced in May 1957.
The first prototype Herald (manufacturer's designation: H.P.R.3) was re-engined with two Darts and made its first flight in this form on March 11, 1958, and the second prototype was similarly re-engined. This air-

Ilyushin Il-18 of Aeroflot (Ivchenko AI-20 turboprops)

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craft, G-AODF, and the first production have undertaken demonstration tours to Greece, Turkey, Persia, Pakistan, India and Ceylon as well as to Central and South America, and has been demonstrated in Australia, New Zealand and the Far East.

Under an arrangement announced by the Government in June 1959, three Dart Heralds were to be purchased by the Government at a cost of some £750,000, including spares and crew training. These would be operated by BEA for an initial five-year period over certain Scottish routes where the aerodromes are too small for Viscounts, and were to have been delivered to BEA last summer. The contract between the MoA and H.P. has not yet been signed, though the three aircraft (Series 100) are in production. The first is due to be delivered to BEA towards the end of January, with the two others due to follow in February. The original plan was that BEA would buy these three aircraft from the MoA at the end of a five-year period. Dart Herald is due to be certificated by the end of 1960 at an initial all-up weight of 39,000lb, 40,000lb being expected to be approved shortly afterwards. Flight tests have shown that certification may be expected at 39,000lb in tropical temperatures (ISA+30°C) compared with the ISA+22°C previously expected. Performance at 40,000lb can be maintained at ISA+13°C. Dart Heralds have now flown some 2,000hr.

Basic price: About £185,000.

Flight references: April 10, 1959; March 27, 1959; July 27, 1958; May 2, 1958. Operator's drawing, page 603.

Herald Series 100

Powerplant: Rolls-Royce RDa.7/2 Dart 527 turboprops of 2,100 e.h.p. each driving 12ft 6in Rotor four-bladed propellers.

Dimensions: Span, 94ft 9in; length, 71ft 11in; height, 24ft; wing area, 886 sq ft.

Weights: Max take-off, 40,000lb; max landing, 39,500lb; zero fuel, 36,000lb; capacity payload, 13,300lb (freighter) or 10,160lb (38-passenger version); basic operational, 24,480lb.

Payload accommodation: Cabin volume, 2,198 cu ft; cabin length, 48ft 9in; max width, 8ft 8in; max height, 6ft 5in; usable floor area, 260 sq ft; dimensions of largest entrance, 64in × 65in; max seats, 48.

Fuel capacity: 1,080 Imp gal plus 53 Imp gal water-methanol.

Performance: Cont cruising speed, 237kt (272 m.p.h.) at 20,000ft and 36,500lb, with a fuel consumption of 184 Imp gal/hr; balanced field length at max take-off weight, sea level, ISA, 4,100ft; at sea level, ISA +15°C, 4,700ft; at 5,000ft, ISA and 36,850lb, 5,700ft; landing distance (from over 50ft obstacle, max landing weight), 2,275ft; range A (max payload), 750 n.m. (862 st.m.) with 38 passengers; range B (max fuel), 1,500 n.m. (1,725 st.m.) with 6,700lb payload at 266kt at 23,000ft.

Herald Series 200

During the SBAC display, on September 7, HP announced that Jersey Airlines had placed an order for six Series 200 Heralds, two for delivery in June 1961, two in June 1962, and two in June 1963 (though these last will be handed over in June 1962 if Jersey's traffic demands require). Value of the contract is about £1.75 million excluding spares. The Series 200 has a 42in fuselage stretch forward of the wing, permitting a 50-56 seat layout, compared with 44-47 in the Series 100.

H.P.R.8 A vehicle ferry based on the Herald, this project has a revised fuselage with front clamshell doors. It can accommodate six cars and 30 passengers, or 100 passengers.

HEINKEL *Ernst Heinkel Flugzeubau G.m.b.H., Am neuen Reinhafen 10, Speyer a/Rhein, Germany.*

He.211 Reportedly a twin turboprop, 23-seat transport in the DC-3 replacement category, with STOL capabilities.

HUNTING AIRCRAFT *Luton Airport, Bedfordshire, England (Member of the British Aircraft Corporation).*

President Among the roles for which the President—primarily intended for the executive market—is offered is that of a feeder-liner with up to 12 seats or as a light freighter. The design is supported by substantial sales to the RAF and overseas air forces of the Pembroke.

Powerplant: Two Alvis Leonides 504/5A supercharged piston engines of 540/560 b.h.p. each.

Data appeared in *Flight* for November 20, 1959, page 609.

BAC-107 See page 793.

HUREL-DUBOIS *Boite Postale No 6, Meudon, France.*

HD-321 The remarkable Hurel high aspect-ratio strutted wing was developed to provide great lifting capacity (through a high L/D ratio) for low weight and cost. The first Hurel-Dubois transport prototype was the HD-31, which made its first flight on January 27, 1953; a developed and more powerful version, the HD-32, flew in prototype form on December 29 the same year, and a second prototype followed in February 1954. Later, both HD-32 prototypes were re-engined with Wright Cyclones as replacements for the Pratt & Whitney Twin Wasps fitted earlier, and the first flight in this HD-321 configuration was made on December 22, 1955. Six derivatives—HD-34s—are being delivered to the Institut Geographique National. *Flight* reference also to HD-37 car ferry project, November 20, 1959, page 609.

ILYUSHIN

Il-12 Considerable numbers of these unpressurized 27-passenger transports, with nosewheel undercarriage, continue in service.

Il-14 There are two principal variants of this Il-12 development. The Il-14P, seating 18 or 26 passengers, is standard. It is produced not only in the Soviet Union but in East Germany and by Avia in Czechoslovakia.

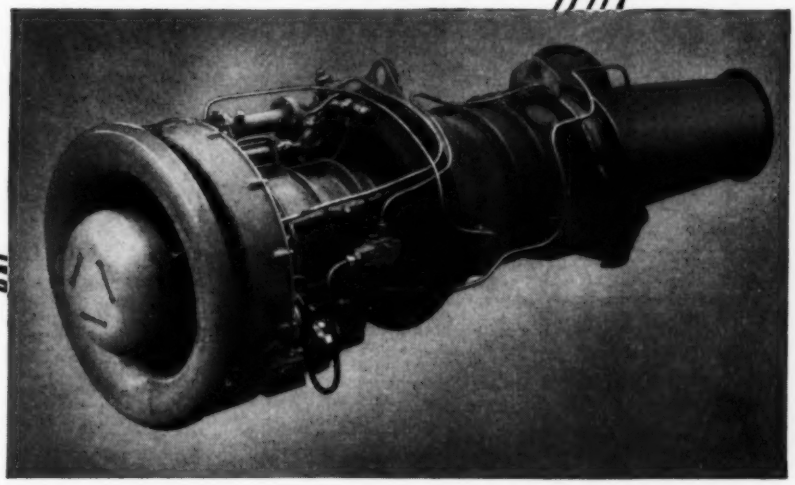
Ilyushin Il-14 (Avia-built) of CSA (ASh-82FNV piston engines)

Blackburn
(LICENSEES FOR TURBOMECA ENGINES)

NIMBUS (A.129)

a free-turbine engine giving over 1000 h.p.—

developed as a result of unique experience in the field of small gas turbine design and production



The Blackburn Nimbus initially is applied to helicopters and has been chosen to power the Saunders-Roe Scout but, like all the other small gas turbines in the Blackburn range,

The Palas
The Palouste
The Turmo
The Artouste

has a wide range of power applications.

BLACKBURN ENGINES LIMITED 43 Berkeley Square, London W.1 Telephone: GROsvenor 5771

E162/a

Member company of the Hawker Siddeley group

AFTER SALES SERVICE BEGINS BEFORE WITH ROTAX

Rotax can offer the aircraft industry a unique After-Sales Service that encircles the world —unique because it begins *before* the sale!

6 ways before

- Recommendations for maintenance and overhaul spares prepared and issued to fit operational plan.
- Spare parts list issued with prices that hold firm.
- Spare parts manufactured and stocked for operators' initial requirements.
- Service and maintenance instructions issued to enable operations to be planned.
- Overhaul tools and test rigs designed ahead of need.
- Operators personnel trained during flight planning stage.

8 ways after

- Liaison visits from service engineers.
- Service engineers on call at main Airports throughout the world.
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- Overhaul facilities available to operators in the U.K., Australia, Canada and U.S.A.
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- Repair and salvage schemes for use for operators.
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ROTAX

ROTAX LIMITED, Willesden Junction, London, N.W.10.

LUCAS-ROTAX (AUSTRALIA) PTY., LTD., Melbourne and Sydney, Australia.

LUCAS-ROTAX LTD., Toronto, Montreal and Vancouver, Canada.

Lockheed L.1649A (cargo conversion) of Lufthansa (Wright R-3350TC-18-EA-2 piston engines)

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The Il-14M has a fuselage lengthened by 3.3ft and seats 24 to 32 passengers.

Powerplant: Two ASh-82T piston engines, driving four-blade constant-speed propellers.

Dimensions: Span, 104ft; length (Il-14P), 69ft 11in; length (Il-14M), 73ft 4in.

Weights: Take-off (Il-14P), 36,400lb; empty, 26,600lb; take-off (Il-14M), 38,000lb; empty, 27,000lb.

Performance: Cruising speed (Il-14P), 173-188kt (200-217 m.p.h.); cruising speed (Il-14M), 173-191kt (200-220 m.p.h.); take-off run (Il-14P), 1,540ft; take-off run (Il-14M), 1,476ft; range (Il-14P), 1,150 miles approx; range (Il-14M), 950 miles approx.

Il-18 In its issue of July 1 *Flight* presented, for the first time in any aviation journal, a detailed technical description of this important turboprop airliner. The type is in extensive service with Aeroflot and also with the East German DLH; CSA, the Czech State Airline and Malev of Hungary. Four have been ordered by Ghana Airways.

A cut-away drawing appears on pages 808-809.

Powerplant: Four Ivchenko AI-20 turboprops of 4,000 e.h.p., driving AB-681 14ft 9in reversible and braking propellers.

Dimensions: Span, 122ft 8¼in; length, 117ft 9in; height, 33ft 4in; wing area, 1,507 sq ft.

Weights: Max take-off, 135,584lb; max payload, 30,865lb.

Payload accommodation: Total pressurized volume, 8,475 cu ft; forward under-floor cargo hold, 470 cu ft; rear under-floor hold, 483 cu ft. Additionally there is an unpressurized baggage compartment of 250 cu ft capacity to the rear of the main cabin. Dimensions of passenger doors, 4ft 7in x 2ft 6in; max seats, 111 (six abreast).

Fuel capacity: Total, 5,213 Imp gal (6,260 US gal).

Performance: Cruising speed at 26,000ft, 388-404 m.p.h. (338-351kt); max range (no reserves), 3,300 n.m. (3,480 st.m.); take-off run, 2,625-3,940ft; landing run, 1,970-2,300ft.

JAPAN *Transport Aircraft Development Association.*

This company was succeeded on June 1, 1959, by Nihon Aeroplane Manufacturing Co Ltd, (NAMCO) which is responsible for the YS-11 feederliner. See under NAMCO.

LOCKHEED *Lockheed Aircraft Corporation, Burbank, California, USA.*

L.10 Design work began on the all-metal L.10 Electra, a twin-engined eight to ten-passenger monoplane, in 1932. It was obviously inspired by the success of the first two "modern-type" transports, the Boeing 247 and Douglas DC-1 but, being smaller, it was not directly competitive. The Electra's first flight was on February 23, 1934, and the type went into service with North West Airways soon afterwards. It was later supplied to Pan American, Eastern, Braniff, Delta and others. A total of 149 were built and 28 remain in service today with eleven operators.

The Electra was succeeded by the L.12, L.14 and L.18 which were built in considerable numbers before and during the War. A few of each of these types remain in airline service today. *Flight* reference: see November 20, 1959, for data.

L.049 The result of discussions in the summer of 1939, the Constellation owed something of its general layout to a four-engined, short-haul project, the L.44 Excalibur, but was much larger, being designed to carry 40 passengers across North America non-stop. The first flight was made on January 9, 1943, and 73 of a military version were ordered by the US Army Air Force. It went into limited use in mid-1944. But the Constellation did not reach airline service until after the War —with TWA in February 1946. Thereafter, a total of 88 were built of the first version—all of which had originally been ordered as military aircraft. Some 66 of these are still in service. The L.049 at first cost about $700,000 (£170,000) but later this was increased to about $800,000 (£200,000). Current price is about £46,000. *Flight* reference: see November 20, 1959, for data.

L.749 In 1946 Lockheed produced the first purely civil Constellation. This was the L.649 which had improved acommodation standards and was known as the "Gold Plate" Constellation. It flew for the first time on October 19, 1946, and went into service with Eastern Air Lines in May 1947. The L.749 followed the 649. It was similar but had more fuel tankage. The first were delivered later in 1947 and many 649s were later converted to 749 standard. The 749A is the same basic aircraft but is cleared to operate at higher weights. A total of 145 L.649, 749 and 749As were built (plus twelve of a military version) and 123 are still in service. Current market price (L.749A): under £100,000. New price in 1950 was $970,000 (£345,000). *Flight* reference: November 20, 1959, includes data.

L.1049C The prototype Super Constellation flew for the first time on October 13, 1950. It had a fuselage 18ft longer, a max take-off weight raised to 120,000lb and was powered by up-rated engines of 2,700 h.p. giving a total increase of 800 h.p. The original production Super Constellations were the L.1049s delivered to Eastern Air Lines and were put into service in November 1951; a total of 24 were built for Eastern and TWA. Lockheed later received an order from the US Navy for a developed version of the Super Constellation to be powered with the new Wright Turbo-Cyclone compound engine of 3,250 h.p. The civil version of the naval Super Constellation was known as the L.1049C and was ordered by TWA in 1950. It flew for the first time on February 17, 1953, and entered service in the following June. It was subsequently ordered by several other operators and was followed in production by the improved D and E versions. A total of 102 L.1049/L.1049E were built (plus about 320 equivalent military models) and 87 are still in service with twelve airlines. New price in 1957 was $650,000 (£230,000).

L.1049G The success of the 1049C, which had been the first civil aircraft with the Wright Turbo-Cyclone compound engine, encouraged Lockheed to produce a series of further developments. The last and most important were the 1049G and H. The "Super G," as it is widely known, first flew on December 7, 1954, and entered service in January 1955 with Northwest Airlines. A total of 104 were subsequently built and 101 are still in service with 16 airlines. The 1049G is primarily a long-haul aircraft, fitted with wing tip fuel tanks. The 1049H is a freighter version of which 53 were built; 50 are still in service with 12 airlines. New price was $1,920,000 to $2,070,000 (£680,000 to £740,000). Current used asking price, £250,000.

Powerplant: Four 3,400 h.p. Wright R-3350-972-TC-18-DA-3, EA-3 or EA-6 compounds driving Hamilton Standard Hydromatic 15ft 2in propellers.

Dimensions: Span, 123ft; length, 113ft 7in; height empty, 24ft 9.4in.

Weights: Max take-off, 137,500lb; landing, 113,000lb; zero fuel, 103,500lb; capacity payload, 24,293lb; weight less fuel and payload, 79,237lb.

Payload acommodation: Cabin volume, 4,800 cu ft; baggage and freight volume, 694 cu ft; cabin length, 83ft 2in; max width, 10ft 9in; max height, 6ft 6in; max usable floor area, 744 sq ft; dimensions of largest door, 27in x 72in; max seats, 99.

Fuel capacity: 6,550 Imp gal (with tip tanks), (7,870 US gal).

Performance: Cont cruising speed, 270kt (310 m.p.h.) at 20,000ft and 131,000lb; corres fuel consumption, 370 Imp gal/hr; balanced field length, 5,800ft; at SL, ISA+15°C, 6,340ft; at 5,000ft, ISA, 7,800ft; landing distance from 50ft, 5,270ft; range A (max payload), 3,620 n.m. (4,160 st.m.); range B (max fuel), 4,185 n.m. (4,810 st.m.); corres payload, 18,315lb; corres cruise speed, 243kt.

L.1649A Lockheed decided in 1954 to produce a final development of the Constellation series which would have a similar, or greater, range than the Douglas DC-7C. Lockheed's modification of the Constellation consisted of an entirely new wing of increased span and aspect ratio as well as a fuselage stretched a further 2ft 7in. The new aircraft, which was known as the L.1649A, flew for the first time on October 10, 1956, and went into service with TWA (as the Jetstream) in May 1957. Although the new wing gave the 1649 even more range than the DC-7C, the extra design work and the later start proved a serious handicap and only 43 L.1649As were sold. There are 42 still in service with TWA, Lufthansa and Air France. The 1649A originally cost about $2,500,000 (£900,000) but this price was later reduced to $2,350,000 (£840,000). *Flight* reference: July 6, 1956.

Powerplant: Four 3,400 h.p. Wright R-3350TC-18-EA-2 compounds driving three-blade Curtiss C.634S-C602 16ft 10in diameter propellers.

Dimensions: Span, 150ft; length, 116ft 1.6in; height empty, 23ft 4.8in; wing area, 1,850 sq ft.

Weights: Mak take-off, 160,000lb; landing, 123,000lb; zero fuel, 116,000lb; capacity payload, 23,000lb; weight less fuel and payload, 91,806lb.

Payload accommodation: Cabin volume, 4,875 cu ft; baggage and freight volume, 593 cu ft; cabin length, 86ft; max width, 10ft 9in; max height, 6ft 6in; max usable floor area, 744 sq ft; dimensions of largest door, 27in x 72in; max seats, 99.

Fuel capacity: 7,990 Imp gal (9,600 US gal).

Performance: Cont cruising speed, 281kt (323 m.p.h.) at 20,000ft and 123,000lb; corres fuel consumption, 417 Imp gal/hr; balanced field length, 6,250ft; at SL, ISA+15°C, 6,534ft; at 5,000ft, ISA, 8,280ft; landing distance from 50ft, 6,000ft; range A (max payload), 4,700 n.m. (5,400 st.m.); range B (max fuel), 5,460 n.m. (6,280 st.m.); corres payload, 10,777lb.

(Continued on page 817)

Commercial Aircraft of the World

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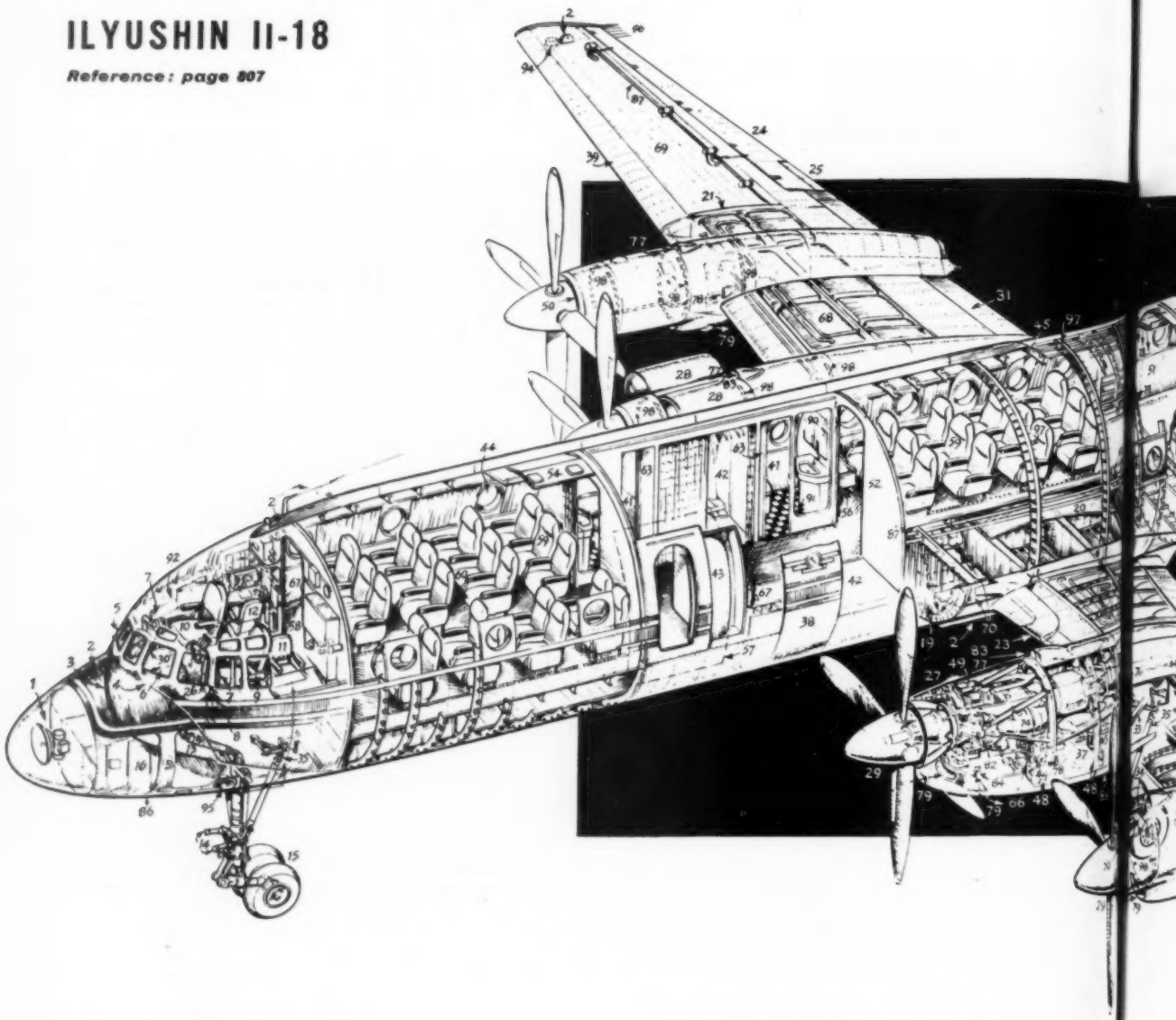
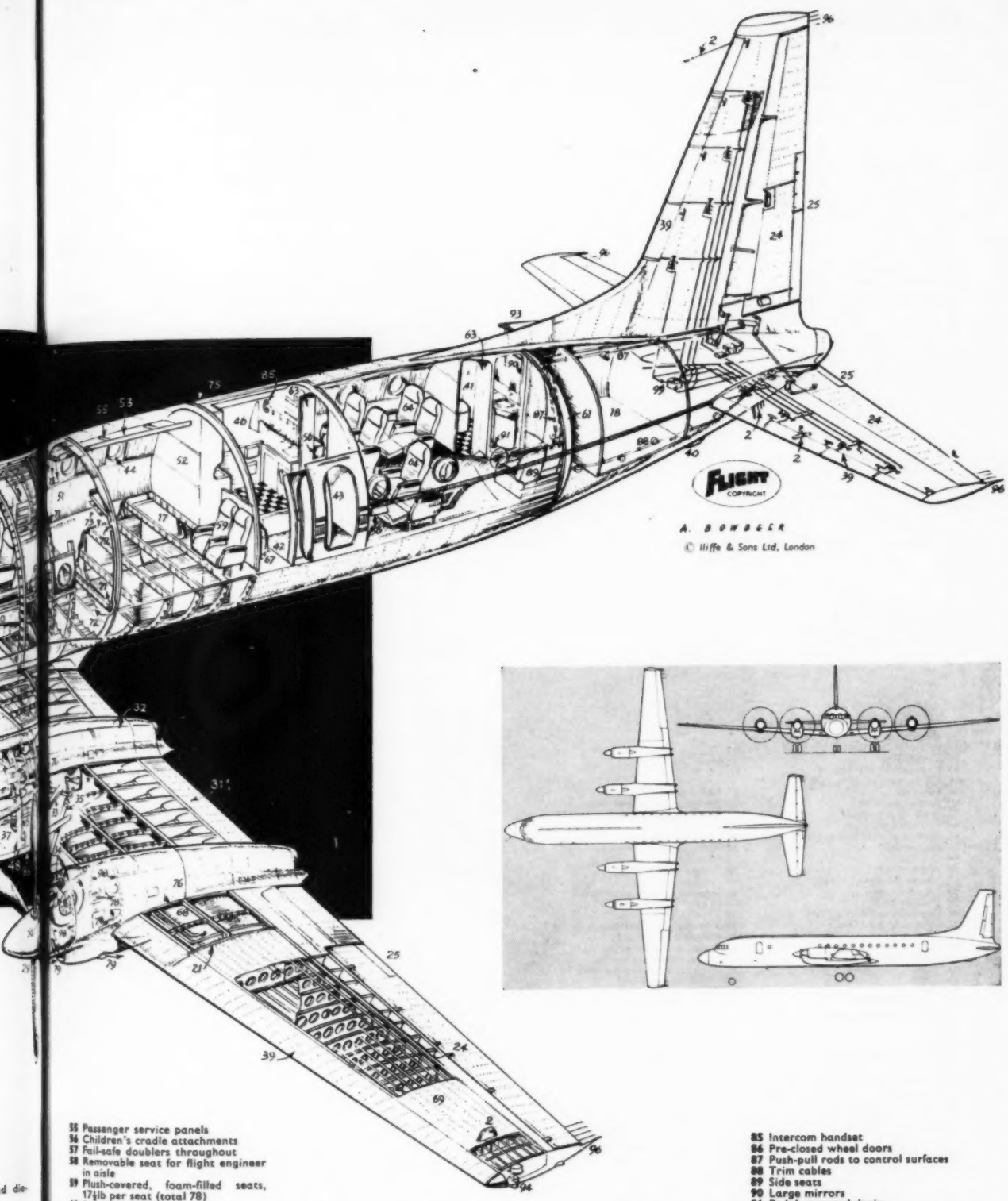
ILYUSHIN Il-18

Reference: page 807



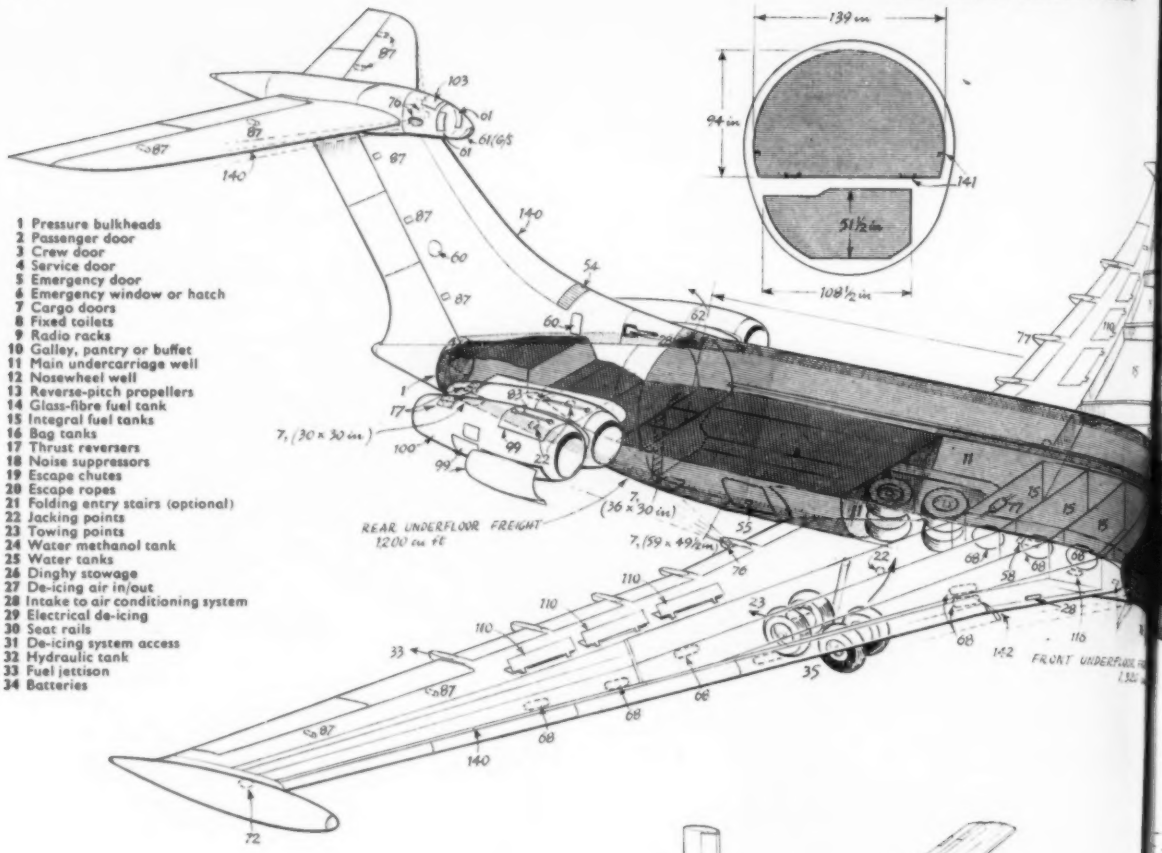
1 Weather radar
2 Aerials
3 Front pressure shell and floor
4 Skin intersection, pressure cabin/nose cone
5 Single silicate-glass windscreen panels, electrically heated
6 Hydraulic windscreen wipers
7 Control column
8 Nosewheel steering wheel (captain only)
9 Captain
10 First officer
11 Navigator
12 Radio officer
13 Hydraulic jack for forward-retracting nosewheels
14 Steering cylinder (45° each side of centre available)
15 Tyres 26in tread diameter
16 Nosewheel and leg box
17 Freight hold doors (total volume 988 cu ft)
18 Unpressurized baggage compartment (247 cu ft)
19 Pressure bulkheads at wing cut-out
20 Three-spar centre wing panel
21 Outboard limits of 20 (about 70ft span)
22 Fire crash-switches under inner nacelles
23 Ram air to (70)
24 Mass-balanced and aerodynamically compensated surfaces
25 Spring-loaded tabs
26 Direct vision panel (open)
27 Ivchenko AI-20 turboprops, 4,000 e.h.p.
28 Hinged side cowlings
29 Auto feathering, reversible propellers with built-in anti-windmilling lock
30 Radar scope at top of instrument panel (scope can be swung aside for use by either pilot)
31 Area-increasing flaps
32 Jet pipes over wing
33 Hydraulic jack for forward-retracting mainwheels
34 Jack folds wheel-beam against leg before retraction
35 Drag-brace and up-lock
36 Sway braces with nacelle doors
37 Bogie bay under firewall
38 Ice-protection strip
39 Electro-thermal de-icing (four phases)
40 Tail bumper
41 Toilets
42 Wardrobes
43 Doors (pull-in and slide)
44 16in windows
45 Four emergency exits
46 Buffet/galley
47 Mainwheel tyres 33in tread diameter
48 Titanium firewalls
49 Auxiliaries gearbox (two starter/generators and hydraulic pump)
50 Thin-lipped engine air intake, with 10th-stage bleed air de-icing
51 Laminated plastic veneer below windows
52 "Pavinol" fireproof plastic trim
53 Continuous baggage racks
54 Central roof lights



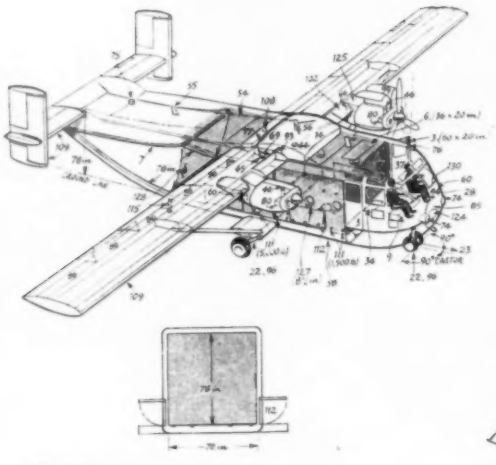
A. BOWDLER

© Iliffe & Sons Ltd, London

55 Passenger service panels
56 Children's cradle attachments
57 Fail-safe doublers throughout
58 Removable seat for flight engineer in aisle
59 Plush-covered, foam-filled seats, 17½lb per seat (total 78)
60 Seat-back tables
61 Rear pressure bulkhead
62 Emergency gas braking system
63 Folding doors
64 "Slumberette" seats (luxury class)
65 Nitrogen bottles for pressurizing hydraulic accumulators
66 Fire suppression bottles (three in each inner nacelle)
67 Portable fire-extinguishers (CO_2)
68 Ten flexible fuel tanks each wing
69 Integral tank—outer wing
70 Heat exchangers: cold-air units
71 Conditioned air to cabin
72 Used cabin-air to underfloor freight holds
73 Individual cold-air louvres
74 Engine oil tank
75 11ft 6in dia fuselage
76 Air-cooled skin under jetpipes
77 Turbine shroud cooling air intake
78 Fire zone vent-air
79 Oil cooler airflow
80 Tension springs to tailpipe
81 Rear mounting spigot
82 Flexible mounting point on compressor casing
83 Cooling air to generators
84 Oil-cooler-flap actuator
85 Intercom handset
86 Pre-closed wheel doors
87 Push-pull rods to control surfaces
88 Trim cables
89 Side seats
90 Large mirrors
91 Pedal-operated drain
92 Starboard console (air conditioning, warning lights)
93 Door to 1B
94 Retractable landing-lamps
95 Retractable taxi-lamps
96 Rigid static dischargers
97 Three heavy frames at wing-spar stations
98 Fire suppression spray rings
99 Rotary distributor to (39)

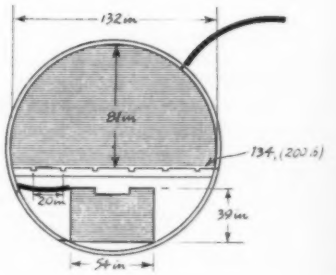


1 Pressure bulkheads
2 Passenger door
3 Crew door
4 Service door
5 Emergency door
6 Emergency window or hatch
7 Cargo doors
8 Fixed toilets
9 Radio racks
10 Galley, pantry or buffet
11 Main undercarriage well
12 Nosewheel well
13 Reverse-pitch propellers
14 Glass-fibre fuel tank
15 Integral fuel tanks
16 Bag tanks
17 Thrust reversers
18 Noise suppressors
19 Escape chutes
20 Escape ropes
21 Folding entry stairs (optional)
22 Jacking points
23 Towing points
24 Water methanol tank
25 Water tanks
26 Dinghy stowage
27 De-icing air in/out
28 Intake to air conditioning system
29 Electrical de-icing
30 Seat rails
31 De-icing system access
32 Hydraulic tank
33 Fuel jettison
34 Batteries



Short Skyvan

35 Anti-skid device
36 Air brakes
37 Captain
38 First Officer
39 First Officer/Navigator
40 Navigator
41 Engineer
42 Radio operator
43 Braking parachute
44 Gravity fuel fillers
45 Pressure refuelling/defuelling equipment
46 Oil fillers
47 Water fillers
48 Water methanol fillers
49 Liquid oxygen
50 Oxygen filler
51 Windscreen de-icing filler
52 Hydraulic fluid filler
53 Press-accumulator filler/inflator
54 HF
55 VHF
56 VOR
57 DME
58 ADF
59 Radio altimeter
60 General access panel
61 ILS
62 Loran
63 Electrical service bay
64 Hydraulic service bay
65 Air conditioning equipment
66 Fire suppression bottles
67 Fire control valves
68 Fuel tank access
69 Booster pump access
70 Gauge unit access
71 Fuel vent
72 Landing lamp
73 Taxi lamp
74 Landing/taxi lamp
75 Anti-collision beacon
76 Icing inspection lamps
77 Flap gear access
78 Control lock jack access
79 Other aerials
80 Generator
81 Bleed door
82 Thermocouples
83 Engine hoist
84 Low pressure fuel cock
85 Weather radar
86 Flying control access
87 Flying control power unit access
88 Auxiliary gearbox
89 Ground intercom. socket
90 External electrical supply
91 Ground air conditioning connection
92 Fire access
93 Access to structural joint
94 Access to gyro compass unit
95 Compass detector unit
96 Picketing points
97 Toilet servicing points
98 Fuel pipe access
99 Engine access
100 Jet pipe access
101 Ground de-icing connection
102 Hinged leading edge
103 Trim gear access
104 Windscreen wiper pumps filler
105 Spares stowage area
106 Periscopic sextant
107 Pneumatic reservoir
108 Wing/tail de-icing fluid tank
109 Liquid de-icing
110 Spoilers
111 Freight-lashing points/rails
112 Freight-lashing access panel
113 Steering angle
114 Freight winch
115 Retractable supports
116 Teletype loop
117 Doppler
118 Decca
119 UHF
120 TACAN
121 Automatic-landing aerial
122 Air to APU
123 APU access
124 Combustion heater access
125 Supercharger access
126 Safety-line fittings
127 Window size (inches)
128 Freight-door operating handle
129 Actuator (loading facilities)
130 Electric windscreen wipers
131 Fuel-tank vent
132 Alternator
133 ATC aerial
134 Floor loading (lb/sq ft minimum)
135 Signal-cartridge dischargers
136 Diplomatic-mail locker
137 Lift dumper (to destroy lift after touchdown)
138 Drop-out ram-air turbine
139 Dropping leading edge
140 Hot air de-icing
141 Pallet tracks and rails
142 Leading-edge slot edge access
143 Supernumerary crew

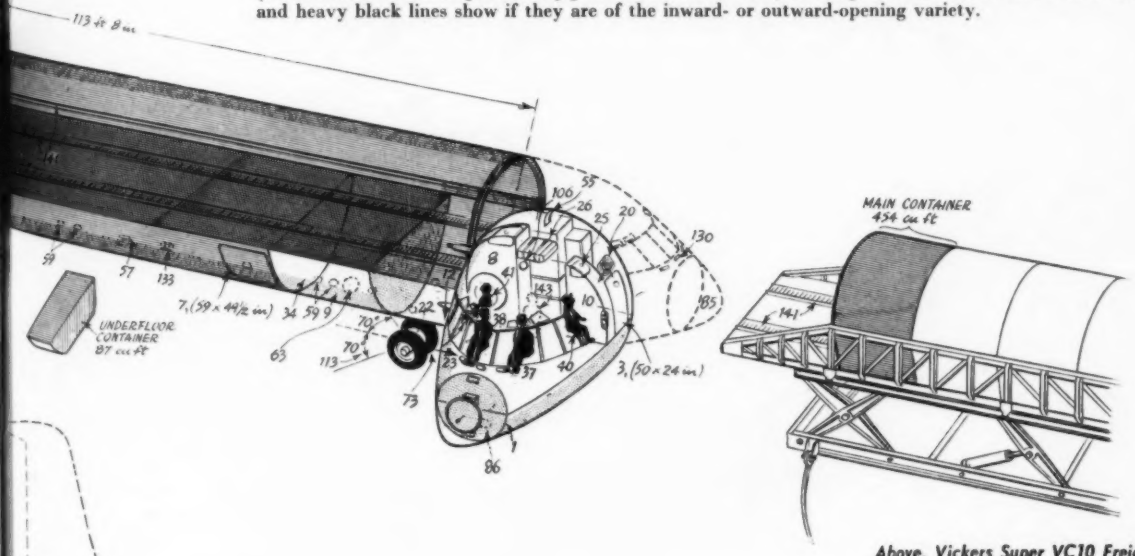


FLIGHT AIRLINE OPERATORS' REFERENCE DRAWINGS

THESE *Flight* copyright drawings (pages 810-816) have been prepared to show the tasks for which the more important commercial aircraft are suited, and some of the features that are in constant use when the aircraft is in service. All drawn approximately to scale, they provide a quick reference to cabin dimensions, doors, access hatches, refuelling points, and so forth.

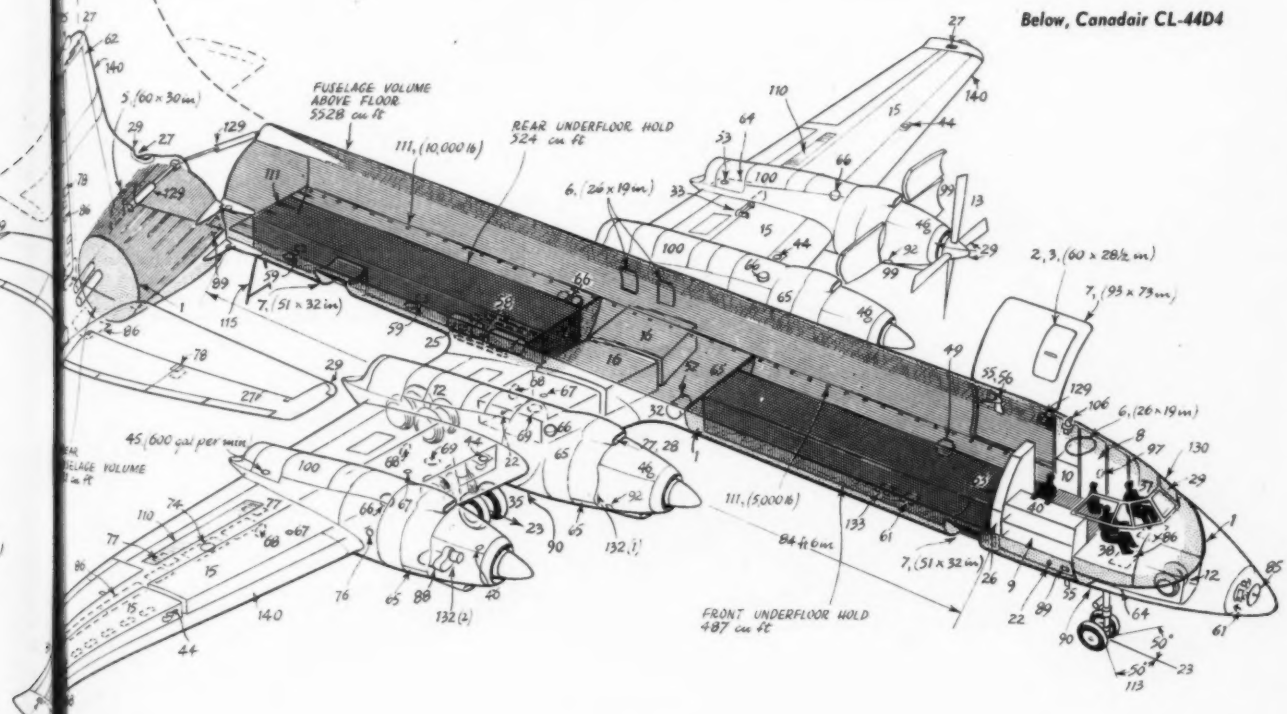
The standard key on the opposite page contains 143 references, and every effort has been made to annotate each drawing with each item in the key. Obviously, particularly in the case of the drawings of the Soviet aircraft, the annotations are inevitably incomplete, since manufacturers' full information has not been forthcoming in every case; the absence of any particular key number from a drawing does not necessarily imply that the particular item concerned is not to be found in the aircraft. Incomplete annotation on the drawings of some of the newer aircraft is inevitable, because detail design is not yet "frozen."

In general, the outline of the pressurized volume is lightly shaded, while line-tone shading is used to denote freight and baggage space. Volumes and linear dimensions are indicated on the drawings. Seating illustrated in the cross-sections is a typical layout shown by the manufacturer—i.e., four-, five-, or six-abreast (these sketches do not represent any particular make of chair). Fuselage doors are indicated on each section, and heavy black lines show if they are of the inward- or outward-opening variety.

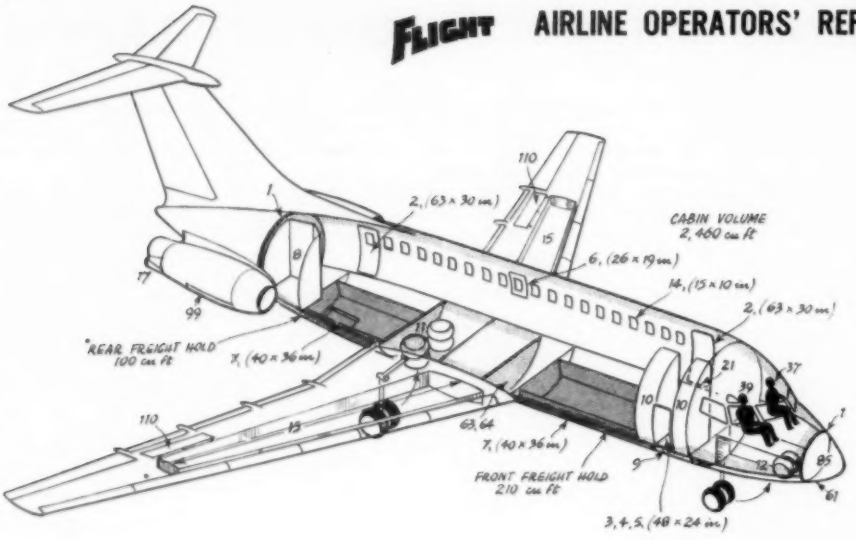


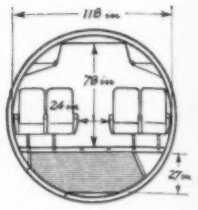
Above, Vickers Super VC10 Freighter

Below, Canadair CL-44D4

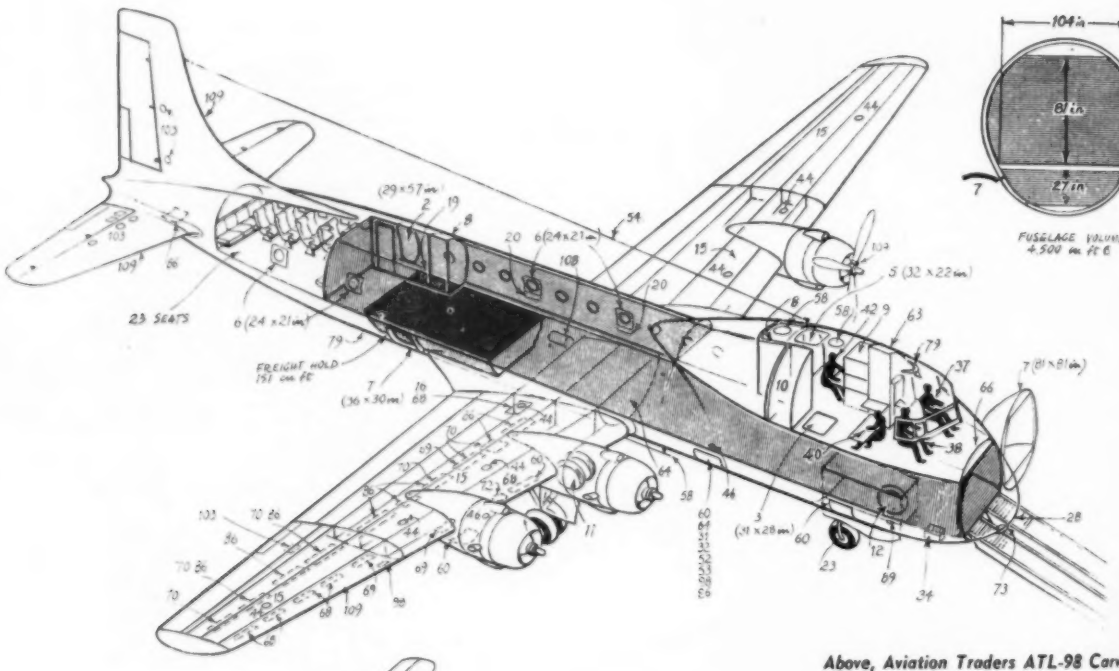


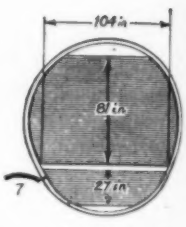
FLIGHT AIRLINE OPERATORS' REFERENCE DRAWINGS


CABIN VOLUME
2,460 cu ft
2, (63 × 30 cm)
6, (26 × 19 cm)
14, (15 × 10 cm)
2, (63 × 30 cm)
*REAR FREIGHT HOLD
100 cu ft
1, (40 × 36 cm)
1, (40 × 36 cm)
FRONT FREIGHT HOLD
210 cu ft
3, 4, 5, (48 × 24 cm)



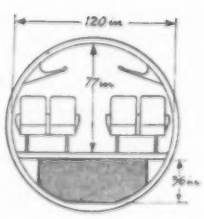
Avro 771

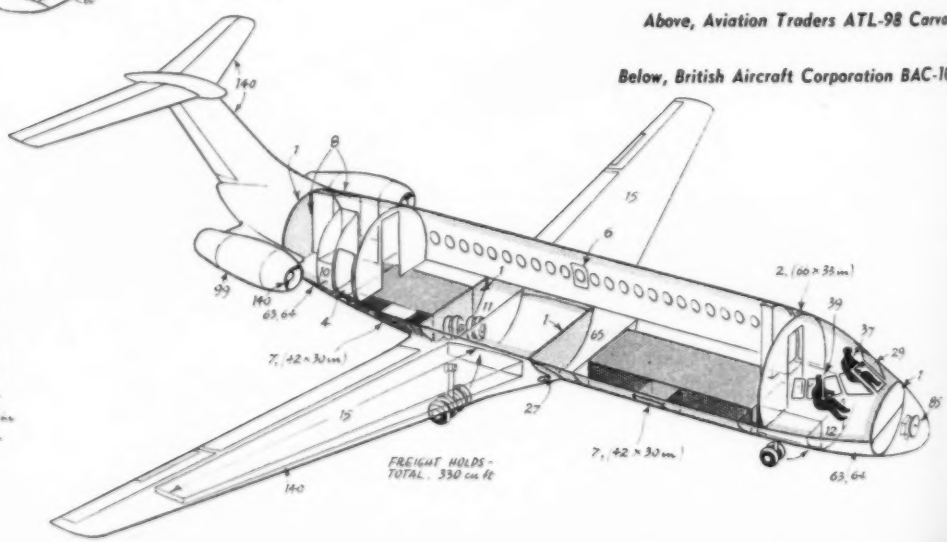


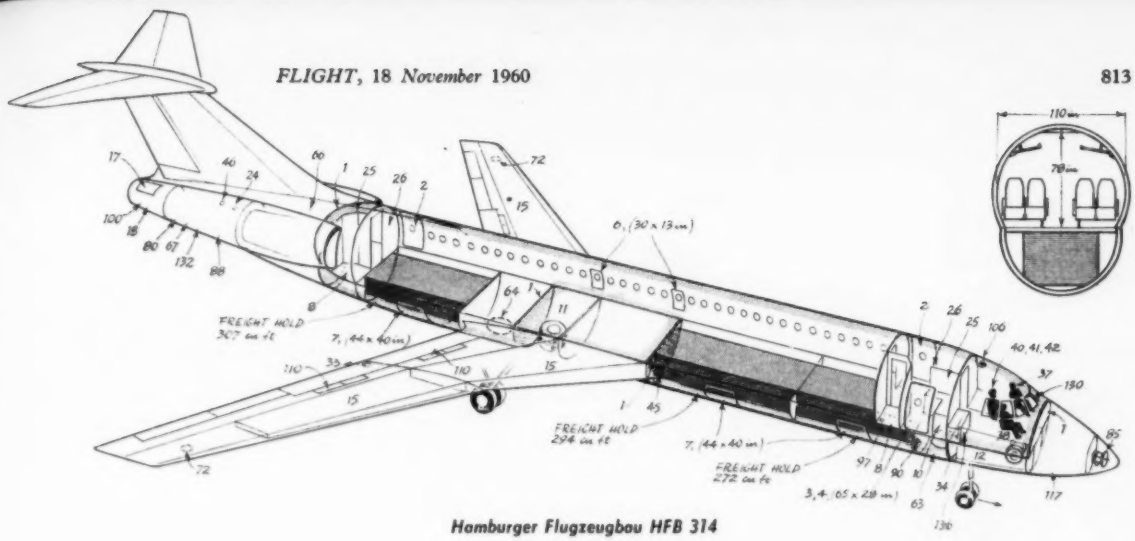


Above, Aviation Traders ATL-98 Carvair

Below, British Aircraft Corporation BAC-107







Hamburger Flugzeugbau HFB 314

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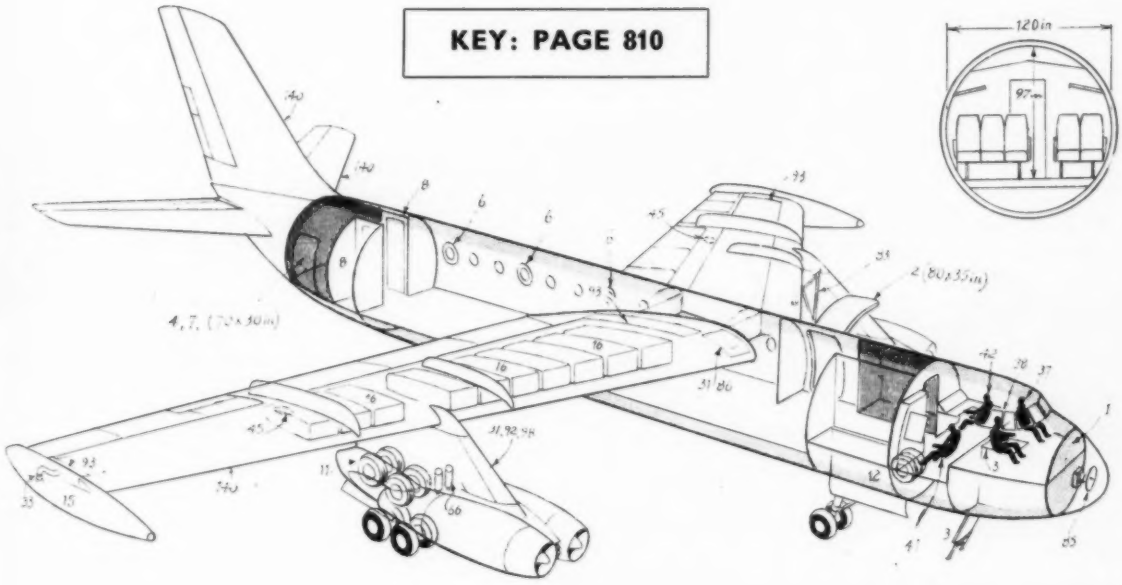
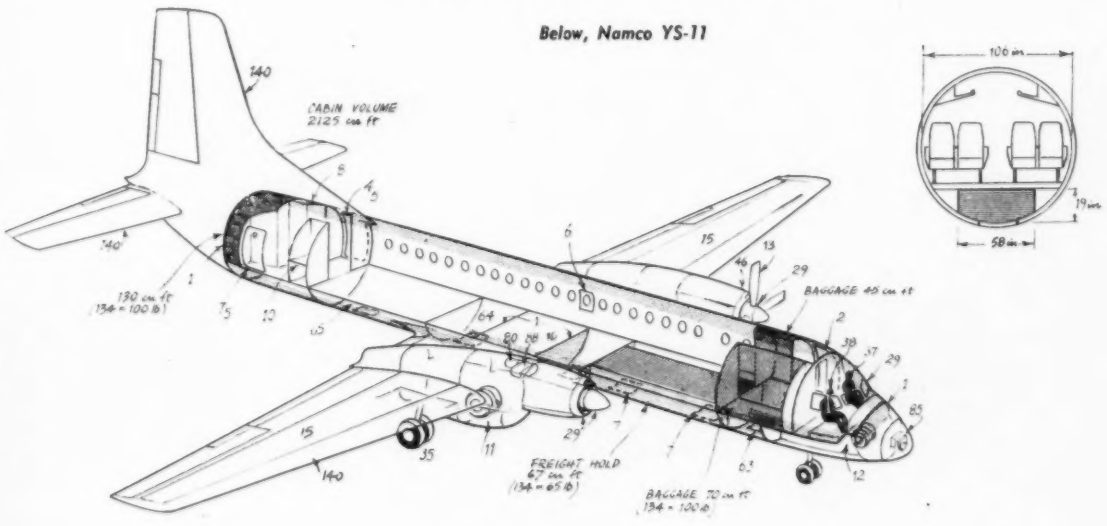
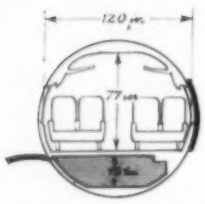


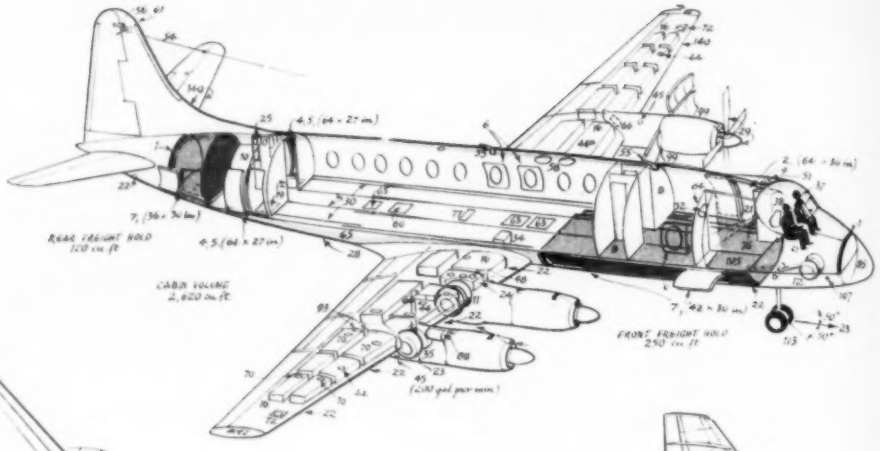
Above, Flugzeugwerke Dresden VEB-152

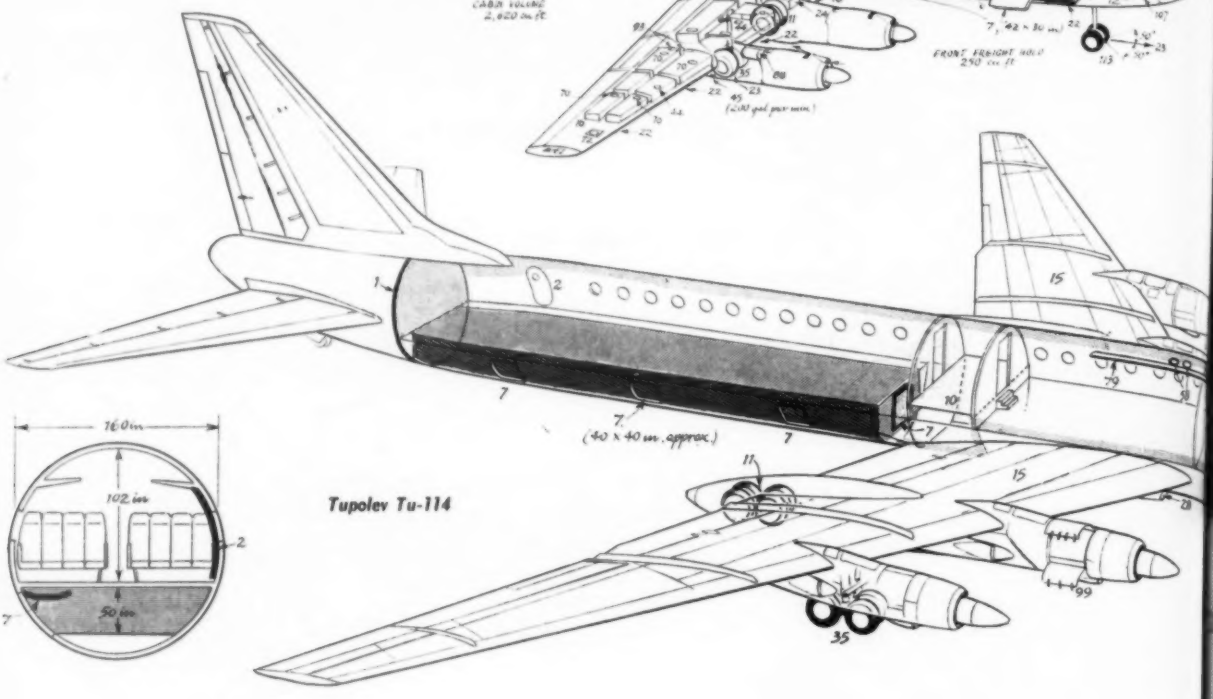
Below, Namco YS-11





Right, Vickers Viscount





Tupolev Tu-114

FLIGHT AIRLINE OPERATORS' REFERENCE DRAWINGS

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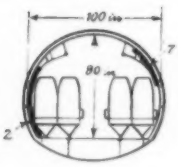
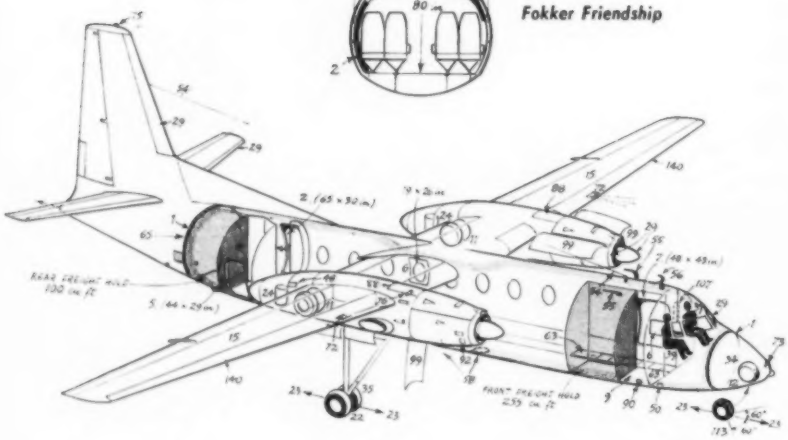
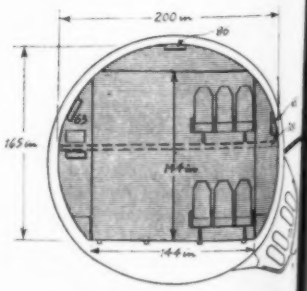


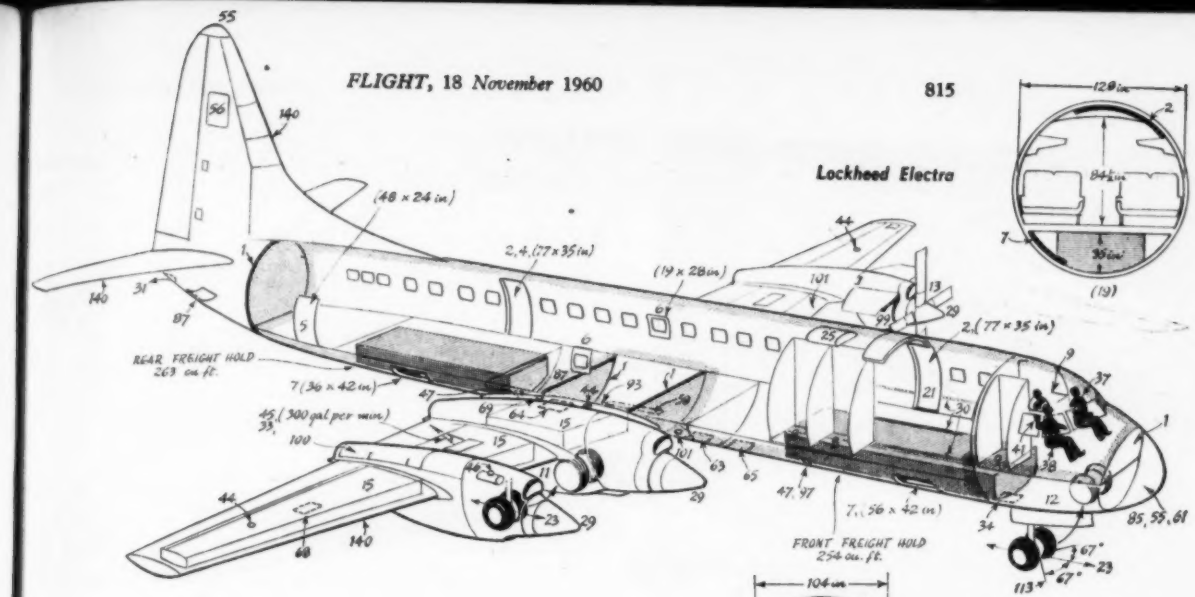
Fokker Friendship

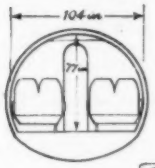


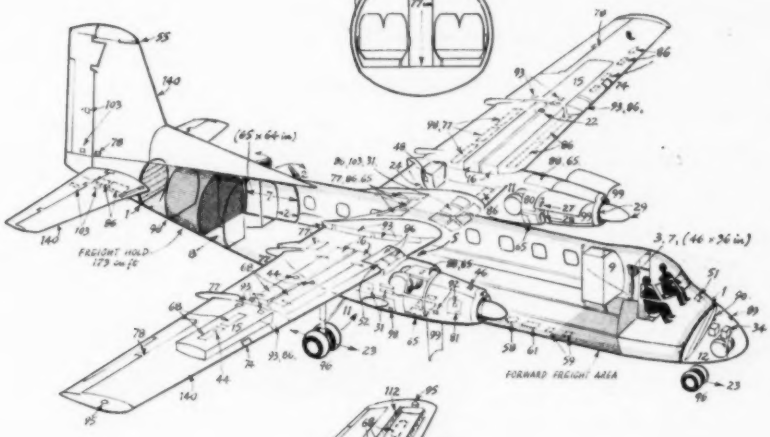


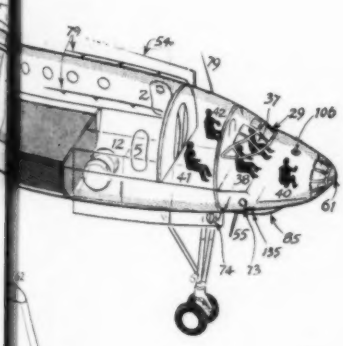
Britannic cabin (see opposite)

Lockheed Electra



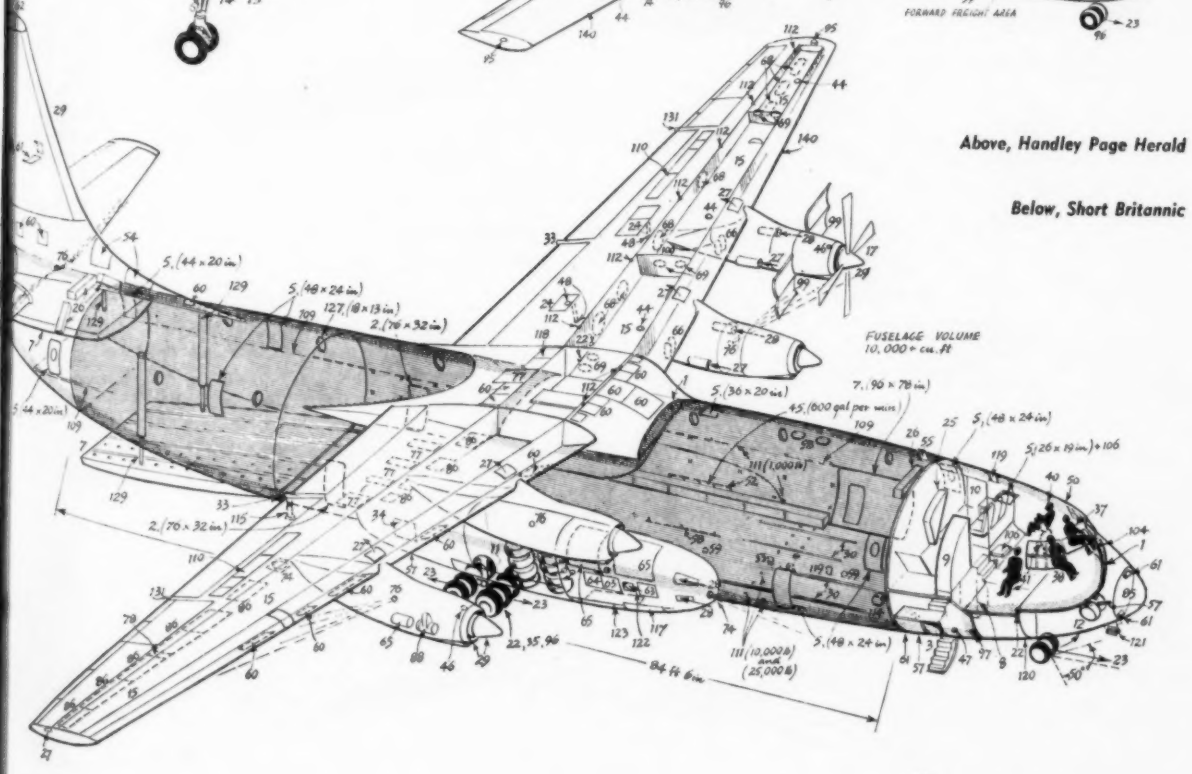




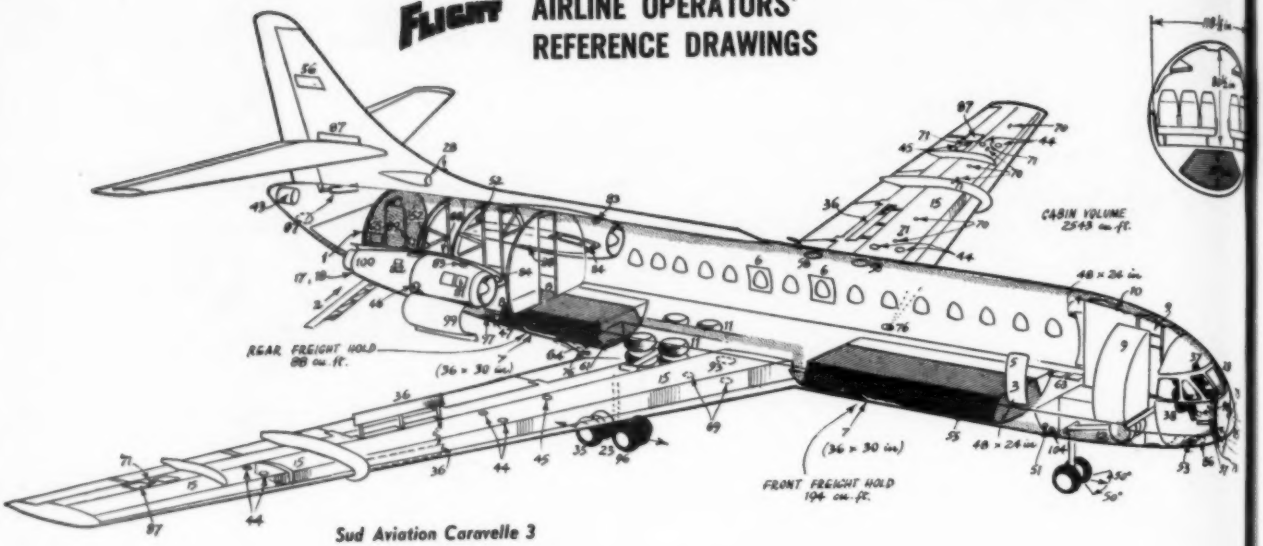


Above, Handley Page Herald

Below, Short Britannic

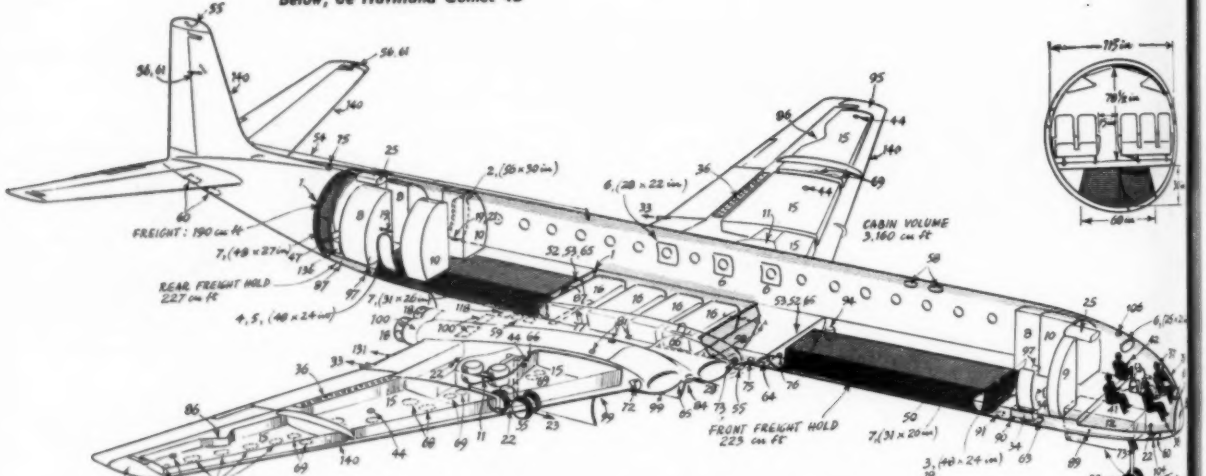


FLIGHT AIRLINE OPERATORS' REFERENCE DRAWINGS



Sud Aviation Caravelle 3

Below, de Havilland Comet 4B



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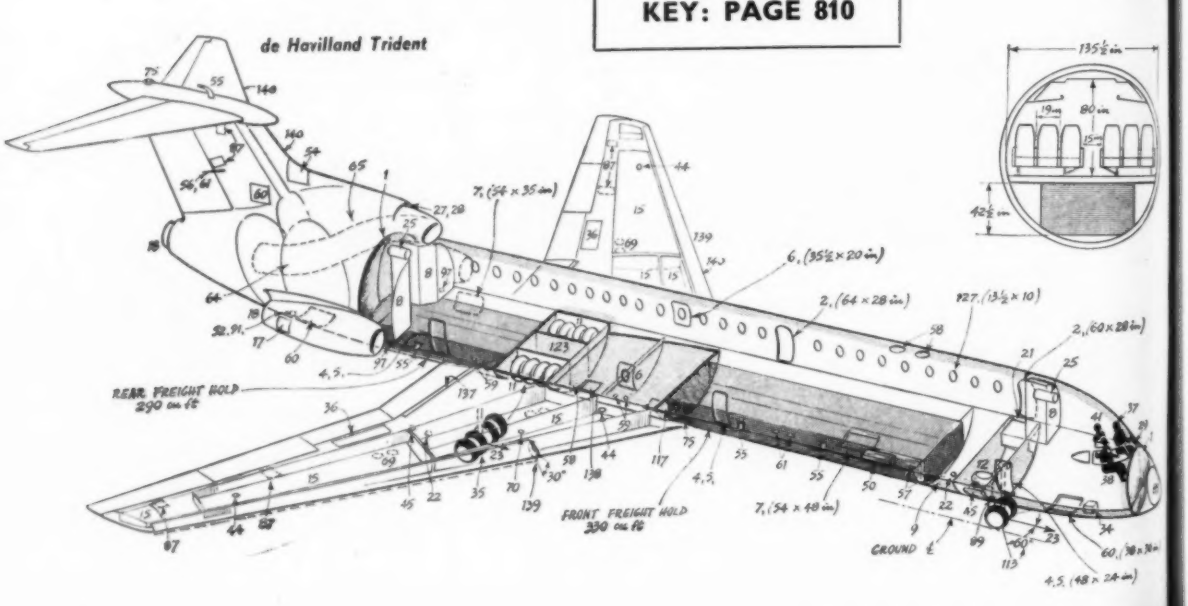
de Havilland Trident



L.188 Electra The Electra was designed to meet a specification issued to the US aircraft industry in January 1955 by American Airlines. The Lockheed project was chosen, and American ordered 35 in June 1955. The specification called for a transport with optimum economics over short and medium stages—a specification for what was loosely-termed "a DC-6B replacement," and Lockheed's experience with the T56-powered C-130 of 1954 encouraged them in the choice of turboprop propulsion.

The first Electra flew on December 6, 1957, and flight tests culminated in FAA certification on August 22, 1958. The first airline to take delivery, in October 1958, was Eastern, who inaugurated the first scheduled services between Miami and New York on January 12, 1959. American's first services were on January 23, 1959.

To date 140 Electras have been delivered to 13 airlines and the order book (accounting for 162 aircraft for 14 airlines) is as follows (*number delivered in parenthesis*): American, 35 (35); Eastern, 40 (40); Braniff, 9 (9); Cathay Pacific, 2 (2); KLM, 12, (10); Western, 12 (6); National, 14 (12); Pacific Southwest, 4 (3); Ansett/ANA, 3 (3); Garuda, 3 (0); Northwest, 18 (10); Qantas, 4 (4); Trans-Australia, 3 (3); TEAL, 3 (3); Allison, 1 (for development); US Navy, 1 (converted into Y/P3V-1 prototype).

Now under way is an extensive "product improvement" programme for the incorporation of revisions in the design found necessary as a result of two accidents (the first to a Braniff aircraft in September 1959, the second to a Northwest aircraft in March 1960). The modifications are being retrospectively made to all speed-restricted delivered aircraft, which are being returned to Lockheed progressively. Main rework is to the powerplant mounting structure. The fault is fully established and is being rectified, and all current production aircraft incorporate the necessary changes.

The L.188C has increased tankage and 116,000lb max weight (initial aircraft were certified at 113,000lb). KLM were the first recipients of the "C," which is the standard aircraft.

Basic price: £928,000. *Flight* references; July 25, 1958; November 1, 1957; July 6, 1956. An operator's reference drawing appears on page 815.

The following data apply to the L.188C:—

Powerplant: Four Allison 501-D13 turboprops of 3,750 e.h.p. each, driving Aeroproducts or Hamilton Standard 13ft 6in propellers.

Dimensions: Span, 99ft; length, 104ft 8in; height, 32ft 10½in; wing area, 1,300 sq ft.

Weights: Max take-off, 116,000lb; landing, 95,650lb; zero fuel, 86,000lb; capacity payload, 26,300lb; weight less fuel and payload, 59,700lb.

Payload accommodation: Cabin volume, 4,812 cu ft; baggage and freight volume, 636 cu ft; cabin length, 76ft 5in; max width, 10ft 8in; max height, 7ft ½in; max usable floor area, 704 sq ft; dimensions of largest door, 78in × 35in passenger, 42in × 52in hold; max seats, 104 at 34in pitch.

Fuel capacity: 5,429 Imp gal (6,520 US gal).

Performance: Cruise speed, 352kt (405 m.p.h.) at 22,000ft and 85,500lb; corres. fuel consumption, 4,200lb/hr; balanced field length, max take-off, sea level, ISA, 5,050ft; ISA+15°C, 6,700ft; 5,000ft, ISA, 7,800ft; landing distance from 50ft; 4,270ft; range A (max payload), 2,110 n.m. (2,430 st.m.); range B (max fuel), 3,140 n.m. (3,610 st.m.); corres. range B payload, 16,800lb; cruise Mach number, 0.615; V_{NE}, 364kt (419 m.p.h.); V_{NC}, 324kt (372 m.p.h.).

JetStar Designed to a USAF specification for a ten-passenger light jet transport, the JetStar is now being produced as a very fast eight-seater executive type against orders from a number of business corporations. In an exceptional effort to be first in the field, Lockheed designed and built the first prototype in the eight months prior to the first flight on September 4, 1957. The heavier and more developed production aircraft, the first of which was rolled out in June, are powered by four P and W JT-12-A6s and equipped with thrust reversers. Two 260-gal external fuel tanks are an optional fitting. By September, 15 JetStars were being assembled or undergoing flight test at Marietta, Georgia. Orders have been placed by Continental Can Co (delivery January 1961), Canadian Department of Transport (delivery June 1961), Ryder System Inc, T. Eaton & Co, Krupps of Essen, and by Jet Executive Transport Services Inc, who might act as sales agents. A small batch has been ordered by the USAF. Basic price: about £426,000, or with de luxe interior, about £434,000. *Flight* references: September 13, 1957; September 20, 1957; December 12, 1958; August 21, 1959; November 20, 1959; and June 10, 1960.

Powerplant: Four Pratt & Whitney JT-12-A6 of 3,000lb static thrust each.

Dimensions: Span, 53ft 8in; length, 60ft 6in; height, 20ft 6in.

Weights: Max take-off, 38,930lb; max landing, 28,000lb; max payload, 2,439lb.

Payload accommodation: Cabin volume, 716 cu ft; max seats, 17.

Performance: Typical cruising speed, 445kt (512 m.p.h.) at 45,000ft and 25,000lb; balanced field length, SL, ISA, 7,000ft; range A (max payload), 2,530 n.m. (2,970 st.m.).

GL-207 Super Hercules Announced in April 1959, the Super Hercules was a development of the C-130A and the heavier, more powerful C-130B Hercules military transports, several hundred of which are in service with the USAF. Provisional orders were placed by Slick and Pan American in July 1959 contingent upon USAF backing, but when this was not forthcoming Lockheed discontinued work on the civil C-130B following "failure of a commercial customer to definitize its contract for five as of July 31, 1960." The GL-207, which remains in the project stage, may be fitted with Rolls-Royce Tynes. *Flight* references: November 20, 1959 (including data); February 5, 1960.

GL-207-42 Another project development, aimed at MATS, is a turbofan swept-wing version of the Super Hercules powered by JT3D-11s of 22,000lb thrust.

MARTIN *The Martin Company, Baltimore 3, Maryland, USA.*

Martin 2-0-2 First twin-engined airliner of completely post-war design to be approved by the CAA for airline use, the Martin 2-0-2 prototype first flew on November 22, 1946. Like the Convair 240, it was aimed at the DC-3 replacement market, but a number of setbacks early in its career enabled the Convair 240 and its successors to capture most of the market, especially overseas. Unlike the Convair-liners, the Martin 2-0-2 is unpressurized. Only 31 were built, for Northwest, LAN (Chile) and LAV (Venezuela); the last two airlines retain their 2-0-2s but those of Northwest have been disposed of.

Martin 4-0-4 of TWA (P & W R-2800-CB16)

Twelve more of an improved version, the Martin 2-0-2A, were supplied to TWA; these are fitted with R-2800-CB16 Double Wasps like the Martin 4-0-4, and have a max take-off weight of 43,000lb and increased fuel tankage. TWA has now withdrawn its 2-0-2As from service. LAN and LAV, with four and two respectively, and Allegheny Airlines and Pacific Air Lines, with eight aircraft each, are the only operators of the Martin 2-0-2 series. Current secondhand market price being asked for 2-0-2s is about £40,000.

Powerplant: Two Pratt & Whitney R-2800-CA18 Double Wasps of 2,400 b.h.p. each with water injection driving 13ft 1in Hamilton Standard three-bladed propellers.

Dimensions: Span, 93ft 3in; length, 71ft 4in; height, 28ft 5in; wing area, 864 sq ft.

Weights: Max take-off, 39,900lb; capacity payload, 9,270lb; weight empty (equipped), 26,930lb.

Payload accommodation: Baggage and freight volume, 281 cu ft; cabin length, 34ft 8in; minimum width, 9ft; max height, 6ft 7in; max seats, 40.

Fuel capacity: 1,010 US gal.

Performance: Cruising speed, 249kt (286 m.p.h.) at 12,000ft; take-off distance to 50ft, max take-off weight, 1,565ft; landing distance from 50ft, 1,720ft at 38,000lb weight; range, with allowances, 552 n.m. (635 st.m.) with 36 passengers and baggage plus 1,000lb cargo; max range, 1,760 n.m. (2,020 st.m.).

Martin 4-0-4 The Martin 4-0-4 is a development of the 2-0-2, from which it differs in being pressurized and having a 39in longer fuselage. CAA type certification of the 4-0-4 was granted on October 5, 1951; the prototype, a modified Martin 2-0-2, had made its first flight on October 21, 1950. A total of 103 Martin 4-0-4s were built, 60 for Eastern, 41 for TWA and two military versions, designated RM-1, for the US Coast Guard. Current secondhand market price: £90,000.

Powerplant: Two Pratt & Whitney R-2800-CB16 Double Wasps of 2,400 b.h.p. each with water injection, driving 13ft 1in Hamilton Standard three-bladed propellers.

Dimensions: As Martin 2-0-2, except length, 74ft 7in.

Weights: Max take-off, 44,900lb; max landing, 43,000lb; capacity payload, 11,592lb; manufacturer's weight empty, 29,126lb.

Payload accommodation: Baggage and freight volume, 316 cu ft; cabin length, 37ft 11in; min width, 9ft; max height, 6ft 5½in; forward door dimensions, 32in × 60in; max seats, 40.

Fuel capacity: 1,350 US gal (1,120 Imp gal).

Performance: Cruising speed, 244kt (280 m.p.h.) at 18,000ft and 38,000lb, with 1,200 b.h.p. per engine; take-off distance to 50ft, max take-off weight, 1,980ft; landing distance from 50ft at max landing weight, 1,750ft; range, with allowances, 805kt (925 st.m.) with 40 passengers and baggage plus 1,000lb cargo; range with max fuel, 2,200 n.m. (2,525 st.m.) at 10,000ft with 5,694lb payload.

MAX HOLSTE *Société Nouvelle des Avions Max Holste, 11 Rue Gosset, Reims, France.*

MH-1521 Broussard Powered by the 450 h.p. Pratt & Whitney R-985 engine, the Broussard is a light eight-passenger transport designed for duties similar to those of the D.H. Beaver. The first prototype flew on November 17, 1952, and the first production aircraft on June 16, 1954. About 50 orders have been met from civil operators but the bulk of production is for the French Services.

MH-250 Super Broussard Another light transport with both civil and military applications, the Super Broussard has about twice the capacity and more than twice the power of the Broussard and is described by its manufacturers as a "*camionette volante*" or a feeder liner for 17-23 passengers. It is powered by two Pratt & Whitney R.1340 piston engines of 600 h.p. each, and the first flight was made on May 20, 1959. This particular aeroplane is, in effect, an experimental prototype for the MH-260 Super Broussard. *Flight* reference, November 13, 1959.

MH-260 Super Broussard The prototype MH-260 first flew on July 29 this year, and has now completed over 100hr. Apart from the powerplant it is generally similar to the MH-250 but the fuselage is

Max Holste MH-260 Super Broussard (Turboméca Bastan turboprops)

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about 4ft 7in longer and there is accommodation for 20-23 passengers. It is understood that a production batch of 100 is to be underwritten by the French Government. Price, fully equipped, is £86,000. *Flight* references: March 27, 1959 and August 14, 1959.

Powerplant: Two Turboméca Bastans producing 957 b.h.p. each for take-off and driving Ratier propellers.

Dimensions: Span, 71ft 8in; length, 58ft 1in; height, 21ft; wing area, 592 sq ft.

Weights: Max take-off, 21,165lb; max landing, 21,165lb; zero fuel, 17,858lb; payload, 7,496lb; weight less fuel and payload, 11,095lb.

Payload accommodation: Cabin volume, 1,183 cu ft; baggage volume, 109 cu ft; cabin length, 21ft 4in; max width, 7ft 2in; max height, 8ft 4in; max floor area, 1,784 sq ft; dimensions of largest door, 65in × 56in; max seats, 30.

Fuel capacity: 466 Imp gal (560 US gal).

Performance: Max cont. cruise speed, 205kt (235 m.p.h.) at 9,300ft and 18,000lb; corres fuel consumption, 108 gal/hr; accelerate-stop length, ISA, sea level, 2,191ft; landing distance from 50ft, 2,368ft; range A (max payload), 275 n.m. (316 st.m.); range B (max fuel), 755 n.m. (870 st.m.); corres payload, 6,750lb; corres speed, 205kt (235 m.p.h.).

MH-262 It was announced in April that the French Government had agreed to finance the 262, the third prototype of the Super Broussard. Similar to the MH-260, this aircraft is to have a circular fuselage pressurized to a differential of 3.2lb/sq in. Max Holste and Nord were commissioned to start production tooling in April.

MH-280 An alternative powerplant to the Bastan is the Lycoming T53 of similar power. The airframe is identical but the designation MH-280 has been adopted for this version.

NAMCO *Nihon Aeroplane Manufacturing Co, Daido Building, No 46, 1-Chome, Minami-Sakumacho Shiba, Minato-Ku, Tokyo, Japan.*

The manufacture of the YS-11 turboprop airliner was first proposed by the Japanese Ministry of International Trade and Industry in 1956. The major aircraft manufacturers set to work on project studies; and in the following year, with a government subsidy, the six largest aircraft manufacturing companies combined forces to launch the basic design work. These six companies were: Mitsubishi Heavy-Industries, Reorganized Ltd; Kawasaki Aircraft Co Ltd; Fuji Heavy Industries Ltd; Shin Meiwa Industry Co Ltd; Japan Aircraft Manufacturing Co Ltd; and Showa Aircraft Industry Co Ltd.

In May 1950 these companies formed the Transport Aircraft Development Association with the object of co-ordinating their efforts in design work, preparation of specifications, wind tunnel tests and construction of a full-size mockup. In June 1959, the Nihon Aeroplane Manufacturing Co was established under the Aircraft Industries Promotion Law with capital jointly provided by the Government and the private companies concerned to succeed the Transport Aircraft Development Association and to be responsible for the production and sales of the YS-11. The board of directors is composed of representatives of the Government and of the "big three"—Mitsubishi, Fuji and Kawasaki.

The paid up capital of the company was 1,850 million yen (about £1.85m) in October 1960 of which 1,050 million yen (£1.05m) was subscribed by the Government and 800 million yen (£0.8m) by the private companies. The capital is to be raised each year to reach a total of 4,200 million yen (£4.2m) in 1963. Of this sum, £2,156,000 will be allocated for manufacturing as follows:—

Mitsubishi are making the fuselage and undertaking final assembly. Their contribution will be about £1,169,000, i.e., just over half;

Kawasaki are making the wing and engine nacelles. Their contribution is about £547,000, or about one quarter;

Fuji are making the tailplane, and contributing about £222,000, about one tenth of the total;

Shin Meiwa are responsible for the rear fuselage, and are contributing rather less than 5 per cent—about £101,000;

Nihon Hikoki are making the ailerons and flaps, contributing £105,000;

Showa Hikoki are making honeycomb structural components, contributing about £12,000.

The aircraft itself is to have the most-developed Rolls-Royce Darts (RDa.10s) and a fuselage to accommodate 60-70 passengers. A mock-up has been built. The designers estimate a demand for about 150 aircraft between 1960-66, including about 40 for export. Several variants are projected, among them the **YS-31** (two RDa.7s), the **YS-12** (two RDa.10s) and **YS-12-4** (four RDa.10s). The first prototype YS-11 is due to be completed at the end of 1961, and the first production aircraft is scheduled to go into operation of Japanese domestic routes during the second half of 1963. The second YS-11 should fly early in 1962, and two others during 1963. *Flight* references: May 23, 1958; February 13, 1959; and August 21, 1959.

Basic price: £360,000 approx.

YS-11

Powerplant: Two Rolls-Royce Dart RDa.10/1 Mk P542 turboprops of 2,775 s.h.p. driving Dowty Rotol 14ft 6in propellers.

Dimensions: Span, 105ft; length, 86ft 3in; height empty 30ft; wing area, 1,020 sq ft.

Weights: Max take-off, 50,265lb; max landing, 48,047lb; zero fuel, 44,092lb; capacity payload, 12,130lb; weight less fuel and payload, 32,561lb.

Payload accommodation: Cabin volume, 2,125 cu ft; baggage and freight volume, 390 cu ft; cabin length, 44ft 1in; max internal width, 8ft 10in; max height, 6ft 6in; max usable floor area, 340 sq ft; dimensions of largest doors, 33in by 66in; max seats, 60 at 34in pitch.

Fuel capacity: 1,560 Imp gal (1,870 US gal).

Water-methanol capacity: 106 Imp gal (127 US gal).

Performance: Opt cost cruising speed at 20,000ft and 48,000lb, 250kt (288 m.p.h.); corres fuel consumption, 0.15 n.m./lb; range A (max payload), 700 n.m. (805 st.m.); range B (max fuel), 1,670 n.m. (1,920 st.m.); corres range B payload, 5,400lb, V_{NE}, 275kt EAS; V_{NO} 245kt EAS; V_{SO}, 72kt EAS.

NORD AVIATION *Société Nationale de Constructions Aéronautiques du Nord, 12 bis Avenue Bosquet, Paris 7e, France.*

Nord 2502 Noratlas The Nord 2502 is a development of the Nord 2500 transport designed for the French Air Force, which was the basis for a series of variations. The prototype 2500, the 2501 powered by two Bristol Hercules 758s of 2,040 b.h.p. each, first flew on September 10, 1949. By 1951 a civil 45-seater (or cargo) version of the 2501 had also been designed and orders were placed by UAT and by an operator in Israel.

The 2502 differs from its predecessor in that it is equipped with two Turboméca Maborés in wing-tip nacelles to improve take-off performance. UAT, who operate six 2052s, introduced the type into service on their African routes in 1954. Other operators are Arkia (two) and Air Algérie (two).

Other developments, not in quantity production, are: **Nord 2503** (Pratt & Whitney R-2800-CB17s); **Nord 2506** (as 2502 but with air-brakes, re-designed flaps and landing gear adjustable for height, now cancelled) and **Nord 2508** (as 2501 but with P & W R-2800-CB17s of 2,500 h.p. and two-stage supercharging). This variant was studied by Kalinga in December 1957, but orders have not so far been placed. *Flight* references: December 27, 1957 and February 26, 1959.

Powerplant: Two Bristol Hercules 758/759 of 2,040 b.h.p. each, built under licence by SNECMA, driving Rotol R.108 propellers, plus two Turboméca Maboré turbojets each of 880lb static thrust.

Data appeared in *Flight* for November 20, page 613.

Transall C.160 Planned as a first co-operative venture between the French and German industries (although Nord 2501s have been built in Germany in quantity) is the Rolls-Royce Tyne-powered C.160 Transall project. Participants are Nord Aviation for France, and Hamburger Flugzeugbau, Weser Flugzeugbau and Blume-Leichtbau and Flugtechnik for Germany. The project is a freighter with rear ramp-loading and an undercarriage retracting into twin pods on the fuselage. Agreement was reached in March this year to build three prototypes plus two further airframes for static and fatigue testing. The first prototype will be built in France, the two others in Germany, and first flight should be in July 1962. The second and third aircraft should fly respectively six and eight months later. Basic price is stated to be about £650,000.

Powerplant: Two Rolls-Royce Tyne 20 turboprops of 5,665 s.h.p. driving de Havilland 18ft propellers.

Dimensions: Span, 131ft 3in; length, 102ft; height empty, 38ft 6in; wing area, 1,722 sq ft.

Weights: Max take-off, 106,325lb; max landing, 100,970lb; zero fuel, 90,057lb; capacity payload, 35,200lb.

Payload accommodation: Cabin volume, 4,662 cu ft; cabin length, 42ft 8in; max internal width, 10ft 4in; max usable floor area, 1,746 sq ft.

Fuel capacity: (3,510 Imp gal) 4,218 US gal.

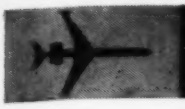
Performance: Typical cruise, 270kt (311 m.p.h.) at 26,250ft and 105,000lb; corres fuel consumption, 2,370lb/hr; range A (max payload), 1,510 n.m. (1,738 st.m.); range B (max fuel), 3,000 n.m. (3,450 st.m); corres payload, 23,000lb.

PEKING AERONAUTICAL INSTITUTE *Peking, Chinese People's Republic.*

Peking NR.1 First flown on September 4, 1958, the Peking NR.1 is believed to be the first aeroplane designed and built in Communist China. It appears to be similar in purpose to the Dove; it carries eight passengers on rather more power—two 520 h.p. piston engines. A general arrangement drawing appeared in *Flight* of April 24, 1959, page 587. Span is approximately 57ft 10in and length 42ft 7in. Cruising speed is given as 162kt (186 m.p.h.) and range as 665 n.m. (670 st.m.). Cruising height is quoted as 2,980 st.m. (15,750ft). Very short field performance is claimed.

PIAGGIO *Via Antonio Cecchi 6, Genova, Italy.*

Piaggio P.166 The first of three prototypes of the Piaggio P.166 flew on November 26, 1957 and production deliveries started at the end of April 1959. About 20 aeroplanes have now been delivered and 21 are to



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be supplied as executive VIP transports to the Aeronautica Militare.

Evolved from the Piaggio P.136 amphibian the installation of the pusher Lycoming GSO-480s has been proved over a decade. As a feederliner, ten seats can be fitted in the cabin and utility bay, allowing up to nine passengers with a single pilot to be carried. A P.166 is operated by Papuan Air Transport of Port Moresby, the first being flown out in 1959, a second following in the spring of this year. *Flight* references: May 23, 1958 and September 5, 1958.

Powerplant: Two Lycoming GSO-480-BIC6 piston engines driving 7ft 9in Piaggio P1033-G4/BS or Hartzell HC-83 × 20-2CL/L9333 three-bladed propellers.

Dimensions: Span, 46ft 9in; length, 38ft 1in; height empty, 16ft 5in; wing area, 286 sq ft.

Weights: Max take-off, 8,115lb; max landing, 8,115lb; capacity payload, 1,830lb; weight less fuel and payload, 5,560lb.

Payload accommodation: Cabin volume, 300 cu ft; baggage and freight volume, 87 sq ft; cabin length, 11ft 8in; max internal width, 5ft 2in; max height, 5ft 9in; max usable floor area, about 60 sq ft; dimensions of largest door, 53in × 26in plus 41in × 11in optional.

Fuel capacity: 185 Imp gal (222 US gal).

Performance: Typical cruise speed, 163kt (188 m.p.h.) at 10,000ft and 8,115lb; corres fuel consumption, 29 Imp gal/hr; range A (max payload), 562 n.m. (647 st.m.); range B (max fuel), 1,040 n.m. (1,200 st.m.); V_{NE}, 192kt IAS; V_{NO}, 152kt IAS; V_{SO}, 64.5kt EAS.

POLAND *Warsaw Aircraft Design Centre, Warszawski Osrodek Konstrukiji Lotniczych, WSK-Okecie, Poland.*

MD-12 Evolved from the earlier and smaller CSS-12 twin-engined aircraft to a Polskie Linie Lotnicze (LOT) specification, this Polish light transport was first shown publicly on September 6, 1959. The design of Prof Dr Francisyek Misztal and Prof Lesyek Duleba, the MD-12 is intended for use mainly as a passenger/cargo or all-cargo transport on short-haul domestic routes. Other versions cover ambulance, agricultural and survey duties, for which the short-field characteristics of the MD-12 are said to be suitable. The low wing has slotted ailerons.

Powerplant: Four Narkiewicz WN-3 air-cooled radial piston engines of 340 b.h.p. each.

Dimensions: Span, 69ft 11in; length, 51ft 10in; height, 19ft; wing area, 592 sq ft.

Weights: Max take-off, 16,530lb; payload, 4,188lb, weight less fuel and payload. 10,912lb.

Payload accommodation: Storage for 550lb baggage; max seats, 20.

Fuel capacity: 209 Imp gal (250 US gal).

Performance: Cruise speed, 154kt (177 m.p.h.) at 8,200ft; take-off to 50ft with engine cut on take-off, 2,625ft; full-payload range (including 30min reserve fuel), 378 n.m. (435 st.m.).

POTEZ *Etablissements Henry Potez, 46 Avenue Kleber, Paris XVI, France.*

Potez 840 Under construction as a private venture at Potez is the 840 feederliner, powered by four Turboméca Astazous. It should fly before the end of the year. A second prototype is being completed at the same time and components are being prepared for a third and a fourth. The aircraft has a crew of two and capacity for 16 passengers two-abreast or 24 facing inwards. Engine control system will be the revolutionary temperature and constant-speed method described in *Flight* for May 6 but a secondary method of controlling power according to intake-to-compressor-outlet pressure ratio ($P_2 - P_1$) will also be provided as a standby. On September 29 Potez submitted an official application to the FAA for certification of the 840. *Flight* references: May 13, 1960 and July 22, 1960.

16-passenger version

Powerplant: Four Turboméca Astazou turboprops of 442 s.h.p. driving Ratier-Figeac propellers.

Dimensions: Span, 63ft 8in; length, 50ft 4in; wing area, 376 sq ft.

Weights: Max take-off, 15,390lb; empty, 8,900lb; payload, 3,230lb.

Fuel and oil: 2,880lb.

Performance: Typical cruise speed, 273kt (315 m.p.h.) at 19,700ft; take-off field length, SL, ISA, 1,770ft; landing distance from 50ft (light), 1,800ft; range B (max fuel), 816 n.m. (940 st.m.).

24-passenger version

As 16-passenger version except:—

Weights: Max take-off, 16,700lb; empty, 8,830lb; payload, 5,250lb.

Fuel and oil: 2,300lb.

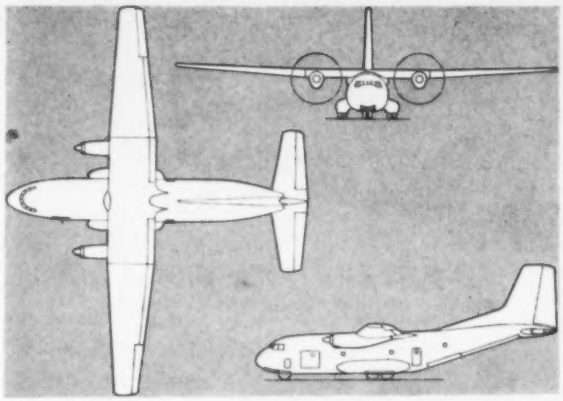
Performance: Typical cruise speed, 269kt (310 m.p.h.) at 19,700ft; take-off field length, SL, ISA, 2,100ft; landing distance from 50ft (light), 2,040ft; range B (max fuel), 543 n.m. (625 st.m.).

SAAB *Svenska Aeroplan Aktiebolaget, Linköping, Sweden.*

Scandia A-2 Although the Scandia first flew 13 years ago—on November 16, 1946—15 of the total of 18 that were built are still in service (with VASP). The aircraft was designed to meet the then-current ICAO and CAA requirements for passenger transport aircraft and was intended to transport passengers over short and medium stages. The first order was placed by SAS in 1948 and the Scandia was introduced into service in 1950.

Powerplant: Two Pratt & Whitney R-2180-E1 Twin Wasps of 1,650 b.h.p. driving 12ft 3in Hamilton Standard Hydromatic propellers.

Data appeared in *Flight* for November 20, 1959, page 614.



Nord Transall C.160 (Rolls-Royce Tyne turboprops)

SAAC *Swiss-American Aircraft Corporation, Delaware, Ohio, USA.*

SAAC 23 This is the reported designation of a proposed US/Swiss twin-jet 6/7-passenger executive project powered by two derated GE J85s of 2,000lb thrust or two Continental J69s of 1,700lb which might be financed by Mr William Lear of Lear Inc. Production would be subcontracted to a number of European manufacturers and production airframes shipped to the US for completion. The two prototypes would be assembled and test flown in Switzerland by Flug-und-Fahrzeugwerke. Wind-tunnel tests have been completed, and it is hoped to roll out the first prototype by December 1961. Delivery is planned for 1963 and the price would be about $250,000. *Flight* reference: October 21, 1960.

Dimensions: Span, 35ft; length, 37ft.

Performance: Cruising speed, 464kt (535 m.p.h.) at 30,000kt; range, 1,500st.m. with reserves.

SCOTTISH AVIATION *Prestwick Airport, Ayrshire, Scotland.*

Twin Pioneer A 16-seat feeder liner with true STOL capacity, the Twin Pioneer is specifically intended for operations in remote areas of the world where available runway lengths are strictly limited. The prototype flew on June 25, 1955, and the first production aircraft followed rather less than a year later, on April 28, 1956. The latest version is the Series 3, in which 605 h.p. Alvis Leonides engines replace the 550 h.p. Leonides of the earlier series.

Five Twin Pioneers have been modified by Scottish at the request of Philippine Air Lines, and supplied with Pratt & Whitney R-1340 Wasps; little structural change was required. Another specialized variant of the Twin Pioneer has a 9ft increase in wingspan (Twin Pioneer outer wings are identical with those of the Pioneer) through the installation of pods on the wing tips carrying electro-magnetic equipment for geographical survey. Some thirty Twin Pioneers have now been manufactured for civil use and airline operators include de Kroonduif (2), Philippine Air Lines (5), Borneo Airways (2), British International Air Lines (2), Scottish Airlines (2), Fison-Airwork (3), Iraq Petroleum (1), and Iran Air Services (4). *Flight* descriptions: July 1, 1960 (air test); September 4, 1959; November 1, 1957; July 6, 1956; and September 30, 1955. Basic price: £63,000 less radio.

Twin Pioneer Series 3

Powerplant: Two Alvis Leonides 531/8B piston engines of 605 b.h.p. driving de Havilland propellers.

Dimensions: Span, 76ft 6in; length, 45ft 3in; height, 12ft 3in; wing area, 670 sq ft.

Weights: Max take-off, 14,600lb; max landing, 14,600lb; capacity payload, 3,550lb; weight less fuel and payload, 10,478lb.

Payload accommodation: Cabin volume, 730 cu ft; baggage and freight volume, 99 cu ft; cabin length, 22ft 9in; max width, 6ft; max height, 5ft 10in; dimensions of largest door, 5ft 3in × 3ft 11in; max seats, 19.

Performance: Cont cruise speed, 114kt (132 m.p.h.) at 5,000ft and 14,600lb; corres fuel consumption, 37.4 gal/hr; take-off field length (Group D), 1,500ft; ground run to unstick, 520ft; landing distance from 50ft, 1,240ft; range A (max payload), 190 n.m. (220 st.m.); range B (max fuel), 680 n.m. (785 st.m.).

SHORT *Short Brothers & Harland Ltd, Queen's Island, Belfast, N Ireland.*

S.25V Sandringham and S.45A Solent The Sandringham was a commercial adaptation of the Sunderland general reconnaissance flying boat, itself derived from the pre-war Empire boats. A dozen are still in airline service, six with Aerolineas Argentinas, three with CAUSA, one with Ansett ANA, one with RAI, one with Airlines NSW.

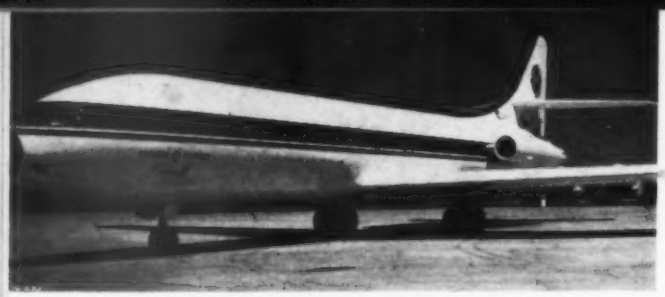
The Solent is also an airliner adaptation of a military flying boat, in this case the Seaford G.R.1, which was originally known as the Sunderland IV. The Solent features more powerful Bristol Hercules 637V or 733 radials and a higher gross weight. It has been used by BOAC, Aquila Airways, Trans-Oceanic Airways and TEAL. The last one in airline service was withdrawn by TEAL in September 1960.

Facts and figures in respect of the Sandringham appeared in *Flight*, November 20, 1959, page 614.

SC.7 Skyvan In May 1959 Shorts announced that they had formed a Light Aircraft Division to develop a general purpose transport the SC.7, as a private venture. The original general conception is attributed to the Miles HDM 105/106 project, now defunct.

In August of this year Shorts named the project Skyvan and released more details. Two aircraft are being built and the first should fly in June 1961. Delivery of certificated aircraft is planned for June 1962.

Simplicity with ruggedness is the keynote of the Skyvan. Though not



Sud Aviation Caravelle 7 (G.E. CJ-805-23 turbojets)

Commercial Aircraft of the World

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claimed to be a true STOL, it will be able to carry 1½ tons of payload in its 6½ft-square fuselage from half-mile fields and strips.

The American-designed engines are to be built under licence by Rolls-Royce.

Flight references: May 8, 1959; September 11, 1959; August 26, 1960; September 2, 1960.

Powerplant: Two Rolls-Royce Continental GTS IO-520 piston engines of 390 h.p. each driving Hartzell propellers.

Dimensions: Span, 64ft 1in; length, 38ft 11in; height, 13ft 10in; wing area, 373ft.

Weights: Max take-off, 8,600lb (stressed for 9,000lb); weight less fuel and payload, 5,330lb; structure 2,697lb.

Payload accommodation: Cabin max width, 6ft 6in; max height 6ft 6in; main hold length and volume, 16ft and 380 cu ft; floor area, 104 sq ft; max seats, 15.

Fuel capacity: 150 Imp gal (180 US).

Performance: Cont cruise speed, 165kt (190 m.p.h.) at 10,000ft; "minimum cost" cruise, 140kt (161 m.p.h.); max range cruise, 105kt (120 m.p.h.); stalling speed, 49kt (56 m.p.h.); take-off distance to 35ft, 1,260ft; landing distance from 30ft, 1,470ft; range A (max payload), 174 n.m. (200 st.m.); range B (max fuel), 930 n.m. (1,070 st.m.); corres payload, 2,000lb.

SC.5 Britannic 3A Short's big freighter project was designed to a requirement for an aircraft that could carry 30,000lb to Australia with only two intermediate stops. This was an RAF Transport Command specification for a strategic freighter. A civil version would have equally impressive payload-range capabilities, both as an 85,000lb capacity-payload freighter or as a 255-seat double decker 'bus. Both variants will have rear ramp-loading. No firm order for the RAF has yet been signed, but production of ten aircraft is in hand at Belfast and Bristol (who are making the wings) and the Britannic should fly early in 1962. A civil version could be made available in 1965 or 1966.

The Britannic owes much to the Britannia, although there is not now much physical relationship; earlier projects were Orion- or Proteus-powered and use of the Britannia wing were contemplated. Aerodynamic, structure and flying control development of the Britannia is being applied to the Britannic 3A and the wing design is broadly similar, although the four Rolls-Royce Tynes are on much wider centres. Design and engineering work is being undertaken by Shorts, Bristol (wing), Boulton Paul (powerplant installation), and Saunders-Roe (rear fuselage). The price of the civil version would be between £1.6 and £1.7m, depending upon the equipment installed. Previous *Flight* references: February 20, 1959, September 4, 1959, September 11, 1959, November 11, 1960, page 741 (blind landing). Operator's drawing: page 815.

Powerplant: Four Rolls-Royce Tyne RTy.12 of 5,730 e.h.p. take-off power at ISA at sea level each driving 16ft de Havilland propellers.

Dimensions: Span, 158ft 9½in; length, 136ft 5in; height, 47ft; wing area, 2,466 sq ft (gross).

Weights: Max take-off, 218,000lb; max landing, 205,000lb; capacity payload, 85,000lb; zero fuel, 196,000lb; weight less fuel and payload, 110,315lb.

Payload accommodation: Freight volume, 10,000 cu ft; cabin length, 84ft 6in; max width, 16ft 1in; max height, 13ft 9in; max usable floor area, 1,014 sq ft.

Fuel capacity: 10,150 Imp gal.

Performance: Cont cruise speed, 320kt (368 m.p.h.) at 20,000ft and 180,000lb; corres fuel consumption, 688 Imp gal/hr; balanced field length, ISA, sea level, 6,950ft; ISA+15°C, sea level, 7,500ft; ISA at 5,000ft, 9,800ft; landing distance from 50ft, 6,700ft; range A (max payload, 1,300 n.m. (1,500 st.m.); range B (max fuel) 5,500 n.m. (6,300 st.m.); corres payload, 25,800lb; corres speed, 304kt (350 m.p.h.) at 28,000ft.

SUD-AVIATION *Société Nationale de Constructions Aéronautiques, 37, Boulevard de Montmorency, Paris.*

S.E.2010 Armagnac The biggest and heaviest piston-engined airliner to see regular service, the Armagnac first flew on January 12, 1949. Nine were built in 1950-53 but none is now operational.

Powerplant: Four P & W R-4360-B13 of 3,500 b.h.p., driving Curtiss propellers. Data appeared in *Flight*, November 20, 1959, page 614.

S.O.30P Bretagne Derived from the S.O.30N (Gnôme Rhone N 48/49) which first flew on February 26, 1945, and from the S.O.30R Bellatrix (Gnôme Rhone 14.Rs), The Bretagne went into production to an Air France specification. About 50 were built up to 1954 and delivered to Aigle Azur (five), Air Maroc (six), Cosara (four), and to the French Services. Two versions were built, the 30P-1 and the 30P-2 with 2,400 h.p. P & W R-2800-CA18s. The following data is for the 30P-1:—

Powerplant: Two P & W R-2800-43 driving Curtiss Electric 13ft 5in propellers. Data appeared in *Flight* for November 20, 1959, page 615.

S.E.161 Languedoc A development of the Bloch 160 and of the Bloch 161, the Languedoc was put into production with Gnôme Rhones in 1945, the first flying on September 17 of that year. Some 70 were built for Air France and LOT. Five are still in airline service with the Spanish operator Aviaco.

Powerplant: Four P & W R-1830-SC3Gs of 1,200 b.h.p. driving Hamilton 10ft 10in propellers.

Dimensions: Span, 96ft 5in; length, 79ft 7in; wing area, 1,200 sq ft.

Weights: Max take-off, 52,250lb; capacity payload, 8,650lb.

Payload accommodation: Cabin length, 36ft 8in; width, 6ft 7in; max seats, 33.

Fuel capacity: 1,580 Imp gal (1,900 US gal).

Performance: Cont cruising speed, 7,500ft, 50,700lb, 189kt (217 m.p.h.); range A (max payload), 1,080 n.m. (1,240 st.m.); range B (max fuel), 1,510 n.m. (1,740 st.m.).

S.E.210 Caravelle The decision to build the Caravelle was taken in January 1953 after a design competition: a French Government contract was awarded in July 1953 to Sud-Est Aviation (which combined with Ouest-Aviation to become Sud-Aviation in 1957), and the first Caravelle flew on May 27, 1955. Air France signed a contract for an initial order for 12 in February 1956. Following certification in April 1959, Air France inaugurated scheduled services on May 12, 1959.

The order book accounts for 101 aircraft, as follows:—

Air France, 35 (20 delivered; SAS, 18 (17 delivered, 4 leased to Swissair); Varig, 2 (complete); Finnair, 3 (complete); Air Algerie, 6 (4 delivered); Royal Air Maroc, 2 (1 delivered); Alitalia, 8 (4 delivered); Sabena, 6; General Electric 1 (complete); United Airlines, 20. A further 34 aircraft are on option.

The Caravelle is the pioneer of two particular trends: short-range jet transportation (i.e., over stages of up to 1,000 n.m.) and rear-mounted jet engines, not the least important advantage of which is the unexcelled degree of cabin-quietness. *Flight* references: July 25, 1958, and November 20, 1959.

Caravelle 1 The first production deliveries are of this variant, which is powered by Avon 522s. Without structural modification, higher-powered Avons can be fitted, the designation then becoming Caravelle 3. Operator's drawing, page 605—*Flight*, November 20, 1959.

Powerplant: Two Rolls-Royce Avon 522 (RA.29/1) of 10,500lb static thrust each.

Dimensions: Span, 112ft 6in; length, 105ft; height empty, 25ft 6in; wing area, 1,579 sq ft; sweepback at ¼ chord, 20°.

Weights: Max take-off, 95,900lb; landing, 91,338lb; zero fuel, 76,060lb; capacity payload, 18,300lb; weight less fuel and payload, 57,760lb.

Payload accommodation: Cabin volume, 3,000 cu ft; baggage and freight volume, 483 cu ft; cabin length, 52ft; width, 9ft 10in; height, 6ft 10in; max usable floor area, 646 sq ft; dimensions of largest door, 6ft × 2ft 5in; max seats, 80 (five abreast); corres pitch, 39in first class, 35in tourist.

Fuel capacity: 4,200 Imp gal (5,000 US).

Performance: Typical cruising speed, 397kt (456 m.p.h.) at 32,800ft and 80,900lb; balanced field length, max weight, sea level, ISA, 5,900ft; ISA+15°C, 6,750ft; 5,000ft, ISA, 9,900ft; landing distance from 50ft, 5,315ft; range A (max payload), 1,390 n.m. (1,600 st.m.); range B (max fuel), 2,420 n.m. (2,790 st.m.); corres payload, 4,640lb; corres cruise speed, 398kt (458 m.p.h.); M_{NO}, 0.75; V_{NO}, 300kt EAS.

Caravelle 3 Powered by Avon 527s (RA.29/3) of 11,400lb static thrust, this 101,413lb version is the standard production aeroplane, to which Caravelle 1s can be converted. A *Flight* airline operator's drawing appears on page 816.

Powerplant: Two Rolls-Royce Avon 527 (RA.29/3) turbojets of 11,400lb static thrust each.

Dimensions: As Caravelle 1.

Weights: Max take-off, 101,413lb; max landing, 96,800lb; zero fuel, 77,160lb; capacity payload, 18,300lb; weight less fuel and payload, 58,640lb.

Payload accommodation: As Caravelle 1.

Fuel capacity: As Caravelle 1.

Performance: Optimum-cost cruising speed, 422kt (486 m.p.h.) at 32,800ft and 85,980lb; corres fuel consumption, 0.075 n.m./lb; balanced field length, max weight, sea level, ISA, 5,900ft; ISA+15°C, 6,750ft; 5,000ft, ISA, 8,200ft; landing distance from 50ft, 5,530ft; range A (max payload), 1,600 n.m. (1,840 st.m.); range B (max fuel), 2,310 n.m. (2,660 st.m.); corres payload, 9,273lb; M_{NO}, 0.77; V_{NO}, 30kt EAS.

Caravelle 6N This 1961 production version is again heavier—up to 105,820lb—and takes advantage of the extra thrust of the Rolls-Royce Avon RA.29/6. Aircraft of this mark for Sabena are now nearing completion at Toulouse; Caravelle 3s can be converted to this standard if required.

Powerplant: Two Rolls-Royce Avon 531 RA.29/6 of 12,200lb static thrust.

Dimensions: As Caravelle 1.

Weights: Max take-off, 105,820lb; max landing, 100,750lb; max zero fuel, 79,366lb; capacity payload, 18,141lb; weight less fuel and payload, 61,225lb.

Payload accommodation: As Caravelle 1.

Fuel capacity: As Caravelle 1.

Performance: Typical cruising speed, 444kt (510 m.p.h.) at 32,800ft and 92,700lb; corres fuel consumption, 0.063 n.m./lb; balanced field length, max weight, ISA, sea level, 6,050ft; ISA+15°C, 6,800ft; 5,000ft, ISA, 8,300ft; landing distance from 50ft, 5,840ft; range A (max

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payload) 1,670 n.m. (1,922 st.m.); range B (max fuel), 2,190 n.m. (2,520 st.m.); corres payload, 11,097lb; cruise Mach, 0.77; V_{NO}, 315kt EAS.

Caravelle 6R This variant of the Caravelle differs from earlier marks both in respect of the powerplant—Avon 533s of 12,600lb thrust equipped with thrust reversers—and a new improved cockpit with larger windows. United have placed an order for 20 at a price of £23,214,000. *Flight* references: March 4, 1960.

Powerplant: Two Rolls-Royce Avon 533 RA.29/6 of 12,600lb static thrust.

Dimensions: As Caravelle 1.

Weights: Max take-off, 110,332lb; max landing, 104,982lb; zero fuel, 81,570lb; capacity payload, 18,300lb; weight less fuel and payload, 63,092lb.

Payload accommodation: As Caravelle 1.

Fuel capacity: As Caravelle 1.

Performance: Typical cruising speed, 440kt (506 m.p.h.) at 32,800ft and 92,700lb; corres fuel consumption, 0.0625 n.m./lb; range A (max payload), 1,720 n.m. (1,980 st.m.); range B (max fuel), 2,030 n.m. (2,337 st.m.); cruise Mach, 0.77; V_{NE}, 340kt; V_{NO}, 320kt EAS.

Caravelle 7 It is the Caravelle 7 which is the most likely to be built by Douglas in the US, although Rolls-Royce-powered Caravelles would be constructed to an airline's requirement. Manufacturing rights were acquired by Douglas in February this year and following the sale of a Caravelle to General Electric, who installed GE CJ-805 powerplants, it is this engine that will power US-built aircraft. The Caravelle 7 has a fuselage 3ft 4in longer than that of all other variants and the take-off weight has been increased to 114,640lb. *Flight* reference: February 19, 1960.

Powerplant: Two General Electric CJ-805-23 turbojets of 16,100lb static thrust each.

Dimensions: As Caravelle 1, except length, 108ft 4in; height empty, 29ft 7in.

Weights: Max take-off, 114,640lb; max landing, 109,172lb; max zero fuel, 84,878lb; capacity payload, 19,842lb; weight less fuel and payload, 64,506lb.

Payload accommodation: Cabin volume, 3,100 cu ft; baggage and freight volume, 459 cu ft; cabin length, 55ft 3in; max internal width, 9ft 10in; max height, 6ft 10in; max usable floor area, 672 sq ft; dimensions of largest door, 6ft × 2ft 5in; max seats, 89; corres seat pitch, 36in.

Fuel capacity: As Caravelle 1.

Performance: Typical cruising speed, 440kt (506 m.p.h.) at 30,000ft and 99,208lb; corres fuel consumption, 0.0662 n.m./lb; balanced field length, max weight, ISA, sea level, 6,400ft; ISA + 15°C, 7,000ft; 5,000ft, ISA, 8,400ft; landing distance from 50ft, 5,600ft.

Caravelle 8 This was the version to have been powered by two Rolls-Royce RB.141/11As of 15,000lb thrust each for take-off and equipped with reverse thrust. However, it has now been cancelled. Max take-off weight was to have been 114,640lb—the same as the Caravelle 7.

Caravelle 14 Since news of this RB.141/11A-powered variant first appeared in May, when it was suggested that this would be a Douglas-built aircraft with a new wing giving the aircraft a cruising speed of M0.84, no further details have been forthcoming. Increased speed was to be coupled with an additional fuselage stretch to provide accommodation for 95 passengers. *Flight* reference: May 13, 1960.

Supersonic Caravelle Announced in France in April were plans for a M2.2, 2,500-mile range supersonic transport to be built jointly by Sud-Aviation and Marcel Dassault. Engines would be "British or American" and overseas collaboration is a possibility. *Flight* reference: April 29.

Sud-Dassault turboprop At the same time as Sud Aviation and Marcel Dassault announced plans for collaboration on a supersonic airliner, the proposal was also put forward for joint construction of a twin-engined civil-military turboprop. Range would be 1,500 miles and selling price £110,000.

TUPOLEV

Tu-104 First flown in 1955 (reportedly on June 17 of that year), the Soviet Union's first jet transport made its international debut in March 1956. Since then it has been built in considerable numbers—certainly some hundreds—and it is Aeroflot's staple equipment for domestic and international express trunk-route services.

The aircraft has been exported, in the Tu-104A version, to Czechoslovakian airline CSA, who operate four. Variants are as follows:—Tu-104: original "prestige" aircraft, seating 50; Tu-104A: 70-seater; Tu-104B: version with longer fuselage seating up to 100 in five-abreast seats; Tu-104E: a development with improved engine.

Basic price: reported as 8 million roubles.

Powerplant: Two Mikulin AM-3 turbojets of about 19,000lb thrust.

Dimensions (Tu-104A and B): Span, 113ft 4in; length (Tu-104A), 127ft 5in; length (Tu-104B), about 131ft.

Weights: Max take-off, 160,000-165,000lb.

Payload accommodation (Tu-104B): First cabin seats 30; second, 15; third, 55. Luggage and cargo compartments are 424 cu ft greater in capacity than those of Tu-104A.

Performance: Normal cruising speed, about 435kt (500 m.p.h.); max speed, 550kt (633 m.p.h.); max range, over 2,500 miles.

Tu-114 The world's largest transport aircraft, the Tu-114 is not yet in regular Aeroflot service. In recent months, however, some remarkable world records have been homologated by the FAI. Over a closed circuit of 1,000km and carrying a load of 25 metric tons a speed of 871.38km/hr (541 m.p.h.) was averaged; over 2,000km a load of 25 metric tons was carried at a speed of 857,277km/hr (532 m.p.h.).

Powerplant: Four TB-12 turboprops of 12,000 s.h.p. Eight four-blade contra-rotating propellers of over 18ft diameter, with electric synchronizing and pneumatic emergency feathering.

Dimensions: Span, 177ft 2in; length, 154ft 10in; height, 38ft 8in; wing area, 3,014 sq ft.

Weights: Max take-off, probably in excess of 410,000lb.

Payload accommodation: Passenger capacity, 120-220, depending on range.

Tu-114D A more or less direct conversion of the "Bear" bomber. Mr Tupolev has stated that this type is intended to transport quite a small number of passengers with baggage, mail and other urgent freight over very long distances.

Tu-124 While Great Britain and America are still in the project stage with turbofan short-range airliners, Russia has had a prototype of the Tu-124, meeting generally similar specifications, flying for several months. The standard version has only 44 seats—22 of first-class standard and 22 of a removable variety, apparently less comfortable. One report states that accommodation for up to 68 economy-class passengers is possible. Cruising speed is said to be 500-530 m.p.h. and maximum speed 620 m.p.h. As the photograph shows, the Tu-124 is along Tu-104 lines but is characterized by an uncommonly low undercarriage.

VEB *Volkseigener Betrieb Entwicklungsbau, Pirna, Nr Dresden, East Germany.*

VEB-152 Roughly comparable in capacity and purpose with the Caravelle, the 57-72-passenger BB-152 is the first airliner to be designed and built in either of the two Germanys since 1945. First flight reportedly took place on December 4, 1958, at Dresden, roll-out having been in May 1958. An early 152 was lost with its crew on March 4, 1959. The type is destined for service in quantity with the East German airline.

Further *Flight* references: July 25, 1958; March 27 and April 10, 1959.

The following data are metric conversions, and are believed to be reliable:—

Powerplant: Four Pirna 014 of 6,950lb (3,150kg) thrust each.

Dimensions: Span, 88ft 7in; length, 103ft; height (approx), 30ft; wing area, 1,464 sq ft.

Weights: Max take-off, 105,820lb; landing, 89,500lb; zero fuel, 76,200lb (57 pass.), or 80,200lb (72 pass.); capacity payload, 17,650lb (57 pass. and freight), or 20,400lb (72 pass. and freight); weight less fuel and payload, 33,300lb (57 pass. version); 33,500lb (72 pass. version).

Payload accommodation: No of seats, 57 "normal," 72 tourist five-abreast.

Fuel capacity: Fuel weight with 57 seats given as 9,920kg.

Performance: Cont cruising speed, 442kt (508 m.p.h.); cruising height, 34-38,000ft; "ICAO take-off distance" over 35ft, 4,310ft; landing run at 77,000lb, 2,260ft; range with max payload (20,400lb), 1,080 n.m. (1,240 st.m.); range with 16,000lb payload, 1,350 n.m.

VVB-135 Another product of the East German association of State-owned aircraft factories was mentioned in February under this heading. It is reputed to be a smaller twin-engined version of the VEB-152.

VICKERS *Vickers-Armstrongs (Aircraft) Ltd, Weybridge, Surrey, England.*

Viking Designed as a replacement for the Douglas DC-3, the unpressurized VC1 Viking first flew on June 22, 1945. Three main versions of this 21-27 passenger airliner were produced: the Viking 1A with wings and tailplane of fabric-covered geodetic, the Viking 1 with wings and tailplane of conventional metal construction and—the most numerous variant—the Viking 1B, which featured a 28in longer forward fuselage. A total of 166 Vikings were built, BEA being the first operator.

(*Continued on page 826*)

Tupolev Tu-124 of Aeroflot (Soloviev turbofans)

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VICKERS-ARMSTRONGS VANGUARD

Reference: page 826

Fuselage

1 Ekco E.152/24 weather radar
2 Upward-hinging radome
3 Three windscreen wipers
4 Front pressure bulkhead
5 Electrically heated windscreen panels
6 DV panel (single panel on TCA aircraft)
7 Access panel to underfloor controls
8 Nose-undercarriage box
9 Circuit-breaker panels
10 Crew emergency fixed oxygen supply bottle, 750 litre
11 Taxying lamp
12 Pressure head
13 Static vents
14 Radio racking
15 Additional radio equipment
16 Galley service and emergency-exit door
17 Windows 26in × 19in
18 Emergency-exit windows
19 Emergency-exit door
20 Interlinked upper and lower freight doors, 66in × 46in
21 Forward freight hold, 750 cu ft
22 Aft freight hold, 610 cu ft
23 Freight hold lighting
24 Access to electric inverters, TRUs, master gyro, cooling air to inverters is extracted by the inverter cooling fans
25 Six batteries for 28 V system
26 Stressed floor panels
27 Galley
28 Coat stowage
29 Extended air-steps
30 Forward passenger door, 73in × 42in
31 Aft passenger door, 73in × 42in
32 Retracted air-steps
33 Air-steps hydraulic jack
34 Air-steps folding cam-track
35 Door-opening linkage
36 Parallel-linkage hinges
37 Steward's remote door control
38 Hydraulics bay, access from underneath
39 Hydraulic reservoir
40 Hydraulic accumulator
41 External door release
42 Seat-pitch in this area 36in in 96-seat configuration
43 Seat side-attachment anchorages
44 Tip-up steward seat (two portable oxygen sets under)
45 Washing water tanks
46 Toilets (total four)
47 Toilet servicing
48 Glass-wool insulation
49 Steward call-panel, also provision for controlling cabin temperature
50 Escape-rope stowage
51 Access ladder to freight hold
52 Anti-glare blinds
53 Supernumerary crew-seat
54 Pilot sun-blind
55 Aft pressure bulkhead
56 Main empennage frames
57 Tailplane attachment points
58 Electro-thermal (Spraymat) de-icing
59 Cyclic switch, fuses and contact breakers for item 58
60 Honeycomb-stabilized skin
61 Dielectric tip
62 Detachable leading edges, tailplane and mainplane

Cabin Air System

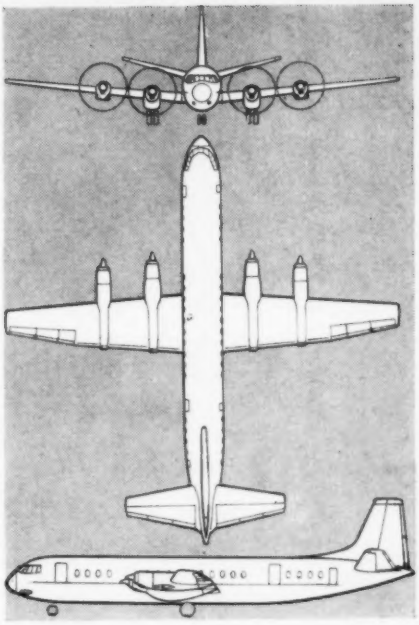
63 Screw-type cabin blower
64 Air intake for item 63
65 Primary silencer
66 Spilled air outlet
67 Silencer for 66
68 Main air supply duct
69 Duct pressure relief valve
70 Ground air supply point
71 Ram air to secondary cooler
72 Secondary cooler (primary to port); cold-air cycle
73 Ground running fan (air turbine-driven axial flow fan draws air through the secondary heat exchanger for the cooling cycle when aircraft is on the ground)
74 Cold air unit
75 Silencer and water-extractor
76 Non-return valve, mixing valve and booster fan
77 Unpressurized-flight valve
78 Recirculating air duct
79 Recirculation check valve interconnected with unpressurized flight valve
80 Recirculation fan
81 Hot air to 76
82 Cold air to 76
83 Conditioned (warm) air
84 Cold-air duct to individual outlets
85 Passenger service box containing individual cold air outlets, reading lamps and steward's call button sliding along the hat racks
86 Wall-heating cells
87 Air extraction to freight holds

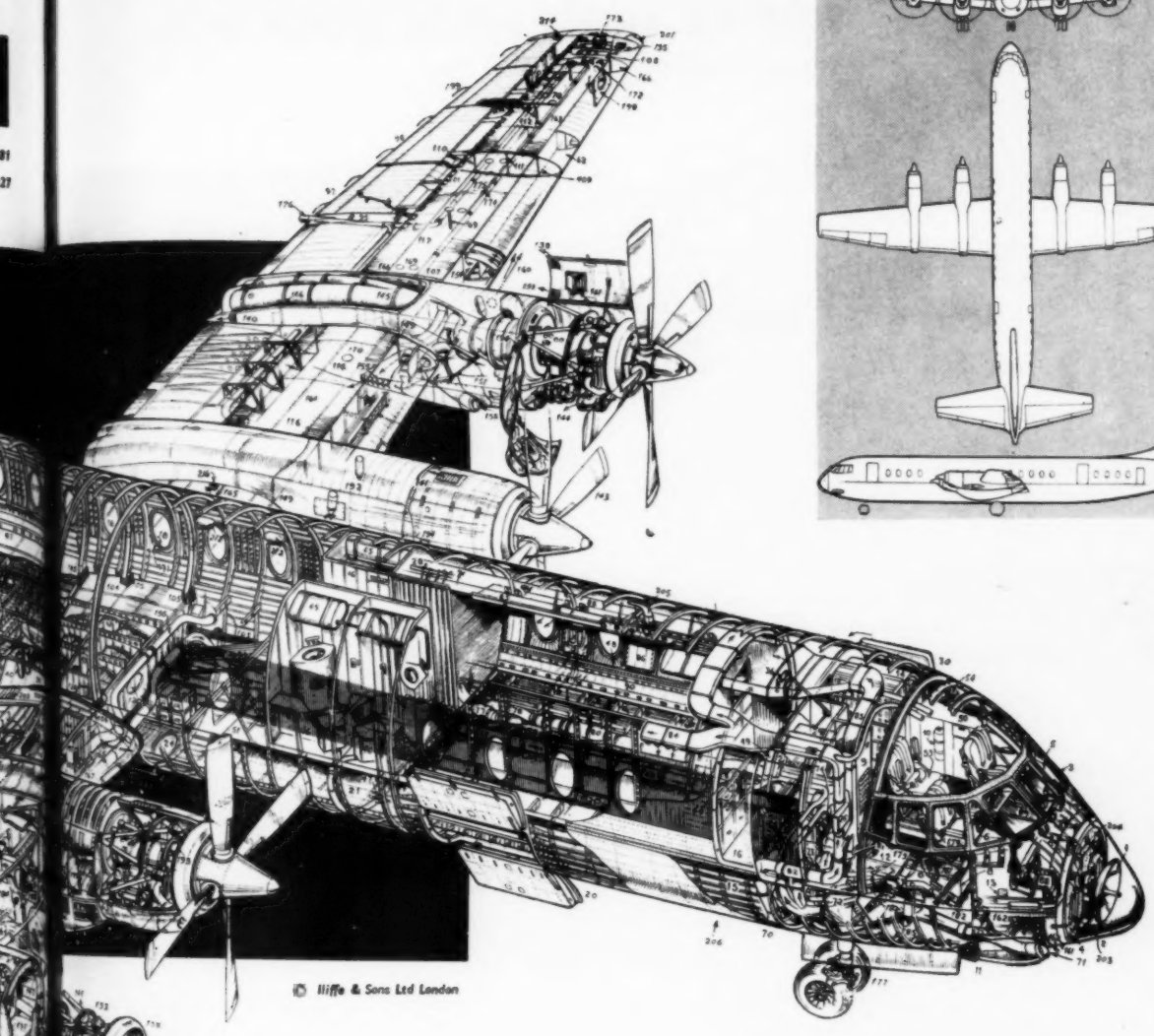
Control Systems

88 Underfloor pedal linkage
89 Push/pull control tubes and cables running below wing torsion box
90 Control-tube swinging brackets
91 Control-run gland box
92 Elevator autopilot servos
93 Rudder autopilot servos
94 Rudder and elevator control locks
95 Control-lock cylinders
96 Spring tab
97 Spring/trim tabs (inboard tab on each aileron and lower tab on the rudder)
98 Geared servo-tab
99 Trim tab
100 Anti-upfloat unit
101 Sealed-balance control surfaces
102 Inspection panels in upper and lower surfaces
103 Engine control runs

Wing structure

104 Centre torsion box (dry)
105 Machined wing/fuselage attachments
106 Butt-strap and web plates for centre-section/inner-wing joint
107 Butt-strap at inner-wing/outer-wing joint
108 Detachable tip unit
109 Torsion-box front web
110 Torsion-box rear web
111 Torsion-box centre member
112 Termination of centre web
113 Machined box-closing web plates
114 Tank-inspection panels
115 Machined, integrally stiffened skin, 54 panels
116 Four panels top and bottom in inner wing
117 Three panels top, four panels bottom, in outer wing
118 Multi-bracket rib/skin joint
119 Leading-edge attachment points
120 Manholes for access to interior
121 Forged fittings for nacelle longerons
122 Boundary ribs to jet-pipe bay
123 Aileron bay
124 Access panel to accessory bay





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Flaps

125 Fowler area-increasing flaps (one section removed)
126 Flap rails
127 Roller track units
128 Cable guide pulleys
129 Flap actuator (hydraulic jack with quick-thread to give irreversible rotary output)
130 Flap torque-tube driving 131
131 Flap-actuating cable drums
132 Port flap sections illustrated in fully-up position

Powerplants

133 Rolls-Royce Tyne 1 turboprops installed as completely equipped engine-change units
134 Rotal accessory gearbox: inners, cabin blower, one alternator, propeller brake unit and hydraulic pump; outers, two alternators, propeller brake unit and hydraulic pump
135 Station 'O' firewall (Zone 1 forward of this bulkhead)
136 Station '26' firewall (Zone 2 between Stn. 'O' and 24)
137 Horizontal firewall (Zone 2a below)
138 Zone 1 venting air, via cowl leading-edge gap
139 Alternator cooling intake
140 Zone 3 venting air
141 Bleed from low-pressure compressor, for discharge of surplus air during starting cycle
142 Engine mounting lugs
143 de Havilland 14ft 6in propellers
144 Airflow through twin oil coolers
145 Flattened jet-pipes
146 Jet-pipe roller guides
147 Jet pipe shroud, with Thermoflex covering
148 Mating ring between engine and jet-pipe
149 Waisted nacelle

Ice Protection

150 Heat exchanger
151 Jet-pipe valve feeding 150
152 Exhaust from 150
153 Ram intake to 150
154 Warm air through leading edge
155 Anti-icing air exhausts (tip, and outboard nacelles)
156 Cross-feed pipe
157 Hot air from inlet guide vanes fed to oil-cooler intake
158 Electro-thermal system on engine intake
159 Slip-rings for electro-thermal system on propeller spinner and blades
160 Leading-edge inspection lamps
161 Ice detector
162 Outside-air-temperature probe
163 Windscreen de-icing fluid tank and pump

Fuel System

164 Integral tanks; outers, 700 Imp gal each; inners, 1,850 Imp gal each
165 Four-tank fuel system, total capacity 5,100 Imp gal
166 Tank end ribs
167 Booster pumps, two per tank
168 Magnetic fuel-level indicators (six)
169 Fuel-gauge tank units (eleven)
170 Gravity fillers
171 Pressure fuelling/defuelling socket and control panel
172 Pressure-relief valve
173 Twin float-operated vent valve
174 Vent pipe from inner tank
175 Outer tank vent pipe
176 Overflow/vent manifold

Undercarriage

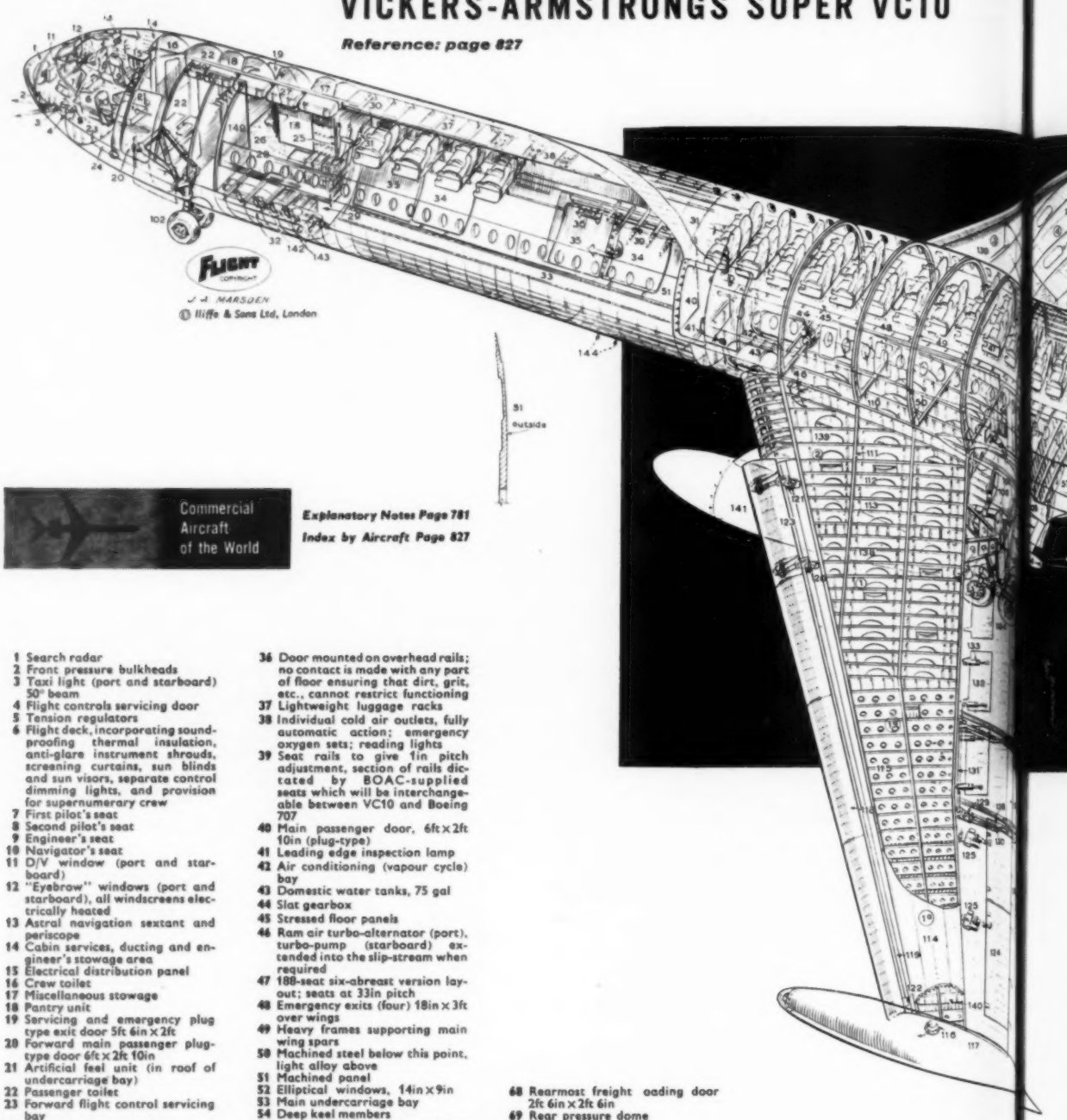
177 Nosewheel tyres 33in × 9.75in
178 Nosewheel steering wheels
179 Jack
180 Breaker strut
181 Up-lock
182 Leg-operated doors, beam and linkage
183 Wheel anti-spin brakes
184 Forward retracting twin-wheel units under box-spar centre member
185 Jack attached to box-spar rear member
186 Breaker-strut to box spar front member (see wing-section overleaf)
187 Dunlop tyres 50in wheels, brakes, Maxaret (Goodyear in TCA aircraft)
188 Blisters in top of wheel-well
189 Leg-well doors linked to wheel-well doors
190 Moving leg operates doors via beam and linkage
191 Door inner skin relieved for wheel

Miscellaneous

192 Two fire suppression bottles each nacelle (two-shot system)
193 Spray-rings, Zones 1 and 2 (Firewire system)
194 Fire access panels
195 Centralized drains, tank and outlet
196 Cowling drains
197 Fuel-tank water drains
198 Retractable landing lamp under each wing tip (access panel open)
199 Static dischargers
200 Glass-fibre cable ducts throughout
201 Flashing navigation lights
202 HF slot
203 Glide slope
204 VHF stand-by
205 VHF
206 Radio altimeter (on centre-line)
207 HF wire
208 ILS localizer
209 Fin tip ILS/VOR localizer
210 VHF No 2 (port side)
211 ADF sense
212 Suppressed ADF loops
213 HF tuning unit
214 Flux detector
215 Freight lashing points
216 Flow break-strip

VICKERS-ARMSTRONGS SUPER VC10

Reference: page 827



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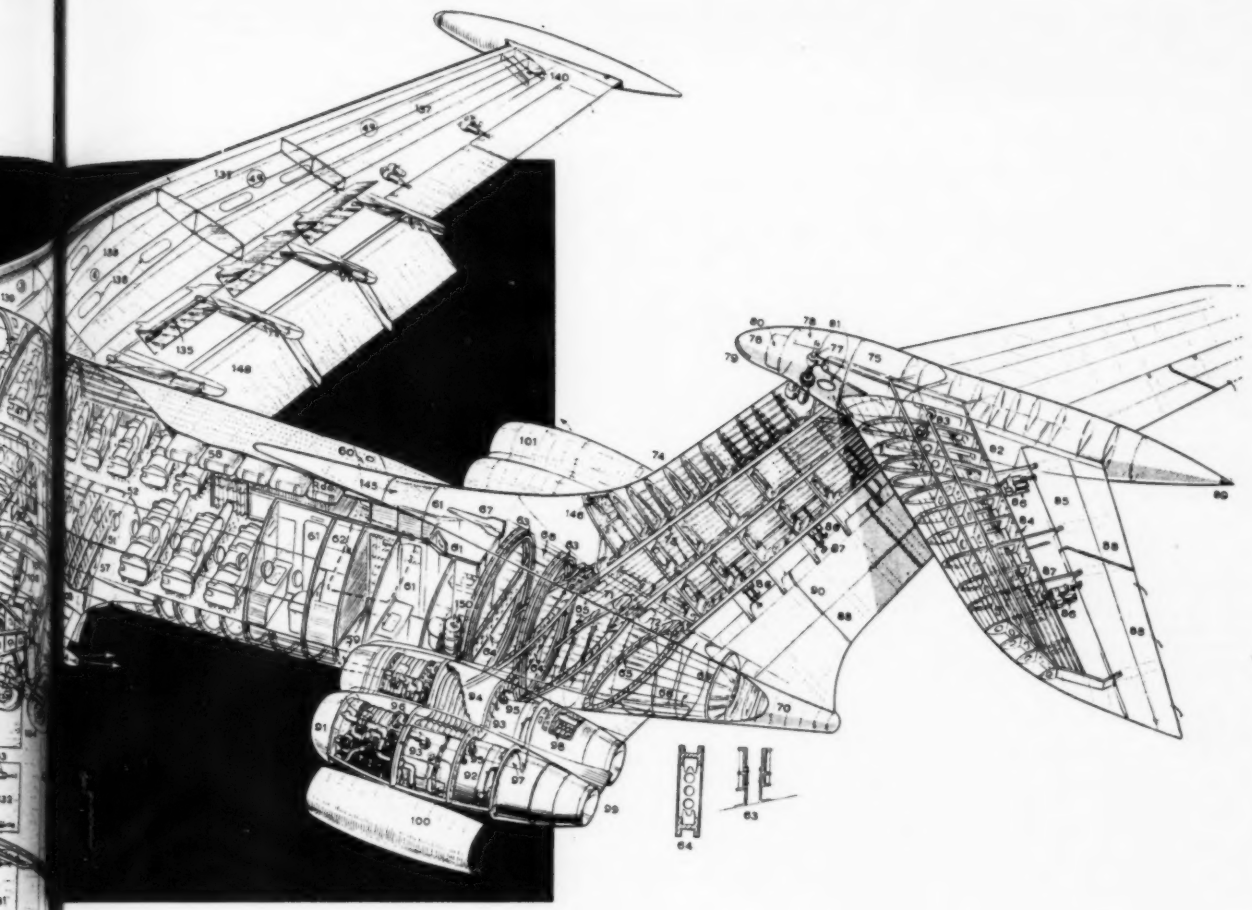
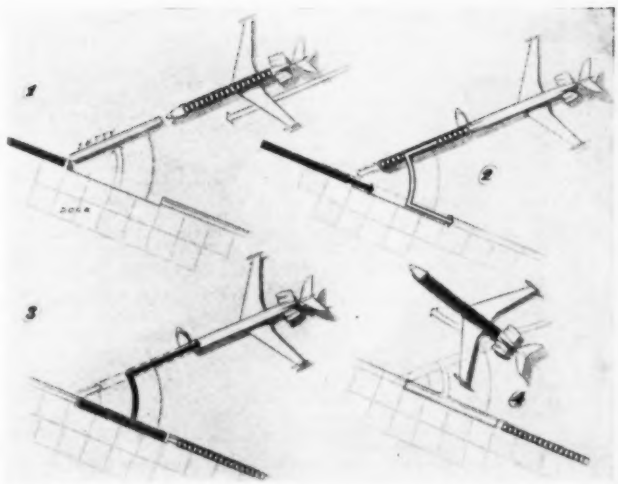
1 Search radar
2 Front pressure bulkheads
3 Taxi light (port and starboard) 50° beam
4 Flight controls servicing door
5 Tension regulators
6 Flight deck, incorporating sound-proofing thermal insulation, anti-glare instrument shrouds, screening curtains, sun blinds and sun visors, separate control dimming lights, and provision for supernumerary crew
7 First pilot's seat
8 Second pilot's seat
9 Engineer's seat
10 Navigator's seat
11 D/V window (port and starboard)
12 "Eyebrow" windows (port and starboard), all windscreens electrically heated
13 Astral navigation sextant and periscope
14 Cabin services, ducting and engineer's stowage area
15 Electrical distribution panel
16 Crew toilet
17 Miscellaneous stowage
18 Pantry unit
19 Servicing and emergency plug type exit door 5ft 6in × 2ft
20 Forward main passenger plug-type door 6ft × 2ft 10in
21 Artificial feel unit (in roof of undercarriage bay)
22 Passenger toilet
23 Forward flight control servicing bay
24 Nosewheel undercarriage bay
25 Furnishing bulkhead
26 Equipment bay access hatch (in flight)
27 Dinghies (four 26-man) and radio equipment
28 Flying and engine control runs, through transverse floor beams
29 Forward radio, oxygen and electronics services bay, fully pressurized and provided with cooling fans to keep temperature constant
30 Radio equipment cooling duct
31 Cabin recirculating air duct
32 Main cabin air delivery ducts
33 Forward freight hold 870 cu ft, completely pressurized
34 Single unit plug-type door, moves in and slides forward 4ft 11in × 3ft 11in
35 Permanent shield covering opened door, providing protection when loading
36 Door mounted on overhead rails; no contact is made with any part of floor ensuring that dirt, grit, etc., cannot restrict functioning
37 Lightweight luggage racks
38 Individual cold air outlets, fully automatic action; emergency oxygen sets; reading lights
39 Seat rails to give 1in pitch adjustment, section of rails dictated by BOAC-supplied seats which will be interchangeable between VC10 and Boeing 707
40 Main passenger door, 6ft × 2ft 10in (plug-type)
41 Leading edge inspection lamp
42 Air conditioning (vapour cycle) bay
43 Domestic water tanks, 75 gal
44 Slat gearbox
45 Stressed floor panels
46 Ram air turbo-alternator (port), turbo-pump (starboard) extended into the slip-stream when required
47 188-seat six-abreast version layout; seats at 33in pitch
48 Emergency exits (four) 18in × 3ft over wings
49 Heavy frames supporting main wing spars
50 Machined steel below this point, light alloy above
51 Machined panel
52 Elliptical windows, 14in × 9in
53 Main undercarriage bay
54 Deep keel members
55 Machined keel longeron member
56 Access holes for inspection
57 Rear freight hold, 1,130 cu ft, completely pressurized
58 Rear dinghies: four 26-man, one radio (drop from roof, mechanically damped)
59 Miscellaneous stowage
60 Rear servicing and emergency plug-type door, 4ft 6in × 2ft
61 Rear toilets (four)
62 Rear freight loading door, 4ft 1in × 4ft 11in
63 Double heavy frames supporting engine beams
64 Engine support beams, machined steel H-section top and bottom, aluminium webs
65 Machined sloping frames supporting the three vertical fin spars
66 Air conditioning air cycle bay
67 Primary flush air intake (port and starboard)
68 Rearmost freight oading door 2ft 6in × 2ft 6in
69 Rear pressure dome
70 Rear tail cone
71 Fin spar pick-up points (Vickers tapered bolts)
72 Inspection panels
73 Fin spar torsion box, stiffened web and rail
74 Leading edge containing thermal de-icing
75 Bullet fairing
76 Removable nose cap
77 Tailplane-incidence hydraulic jack
78 Access panel to tailplane jack, and follow-up shaft
79 Glide-slope aerial
80 ILS aerial
81 Leading-edge inspection lamp
82 High set, variable incidence tailplane adjusted through an angle of +4° to −14°
83 Tailplane pivot point
84 Three-spar torsion box
85 Electrically operated four-section split control elevators
86 Boulton Paul hydro-electric control unit
87 Elliott autopilot actuators integrated into the system; each actuator is connected into the linkage so as to operate all four split surfaces
88 This portion honeycomb-stabilized skin
89 Navigation light
90 Three-section rudder, operating with Elliott autopilot system and yaw damper
91 Electro-thermal system to anti-ice leading edge
92 Rolls-Royce Conway stage 7 (AR. 972) advanced by-pass engines of 24,000lb each
93 Machined steel engine support spectacle beams



94 Engine pod torsion box
95 Fore and aft swinging "A" support bracket
96 Single point attachment front trunnion
97 Stainless-steel firewall isolating engines
98 Thrust reversing unit (inner engines only)
99 Engines at rear giving low asymmetric thrust
100 Lower cowlings hinge down
101 Top front cowlings hinge forward
102 Forward retracting undercarriage, fully steering, low pressure tyres 39in x 13in
103 Nosewheel jack
104 Main four-wheel bogie undercarriage, tyres 50in x 18in-20in
105 Breaker strut
106 Undercarriage jack
107 Undercarriage auxiliary machined spar
108 Undercarriage/fuselage fairing door
109 Wing well door attachment to undercarriage leg
110 Centre wing torsion box, incorporating fuel transfer tanks, 4,220 gal
111 Three-spar (four spars in this area) fail-safe torsion box wing
112 Heavy plate-type ribs
113 Internal manholes giving complete accessibility
114 Multi-machined, integrally stiffened stringer panels
115 "Thiokol" sealed integral wing tanks
116 Retractable landing lamp under each wing tip
117 Wing-tip tanks, 750 Imp gal
118 Four-part hydraulically operated wing slats, opened or closed, no intermediate position
119 Slat torque tube
120 Slat actuator unit
121 Slat jack
122 Slat synchro unit
123 Thermal de-iced leading edge (exhausted through wing tip)
124 Four-part ailerons
125 Boulton Paul hydro-electric control unit (incorporating Elliott autopilot actuators)
126 Driwick static dischargers
127 Five-part electrically actuated Fowler-type flaps
128 Flap worm shaft
129 Flap torque link and carriage
130 Roller guide
131 Torque shaft
132 Three-part spoilers on top surface
133 Spoiler operating hydraulic jack
134 Anti-icing inspection lamp
135 Spoilers shown open
136 Tank inspection panels on top surface
137 Outer tanks, 1,430 Imp gal (1a and 4a)
138 Outer tanks, 1,880 Imp gal (1 and 4)
139 Inner tanks, 3,230 Imp gal (2 and 3)
140 Vent tanks
141 Pod on starboard wing to carry spare engine and lifting tackle (shown on port wing)
142 DME aerial
143 Radio altimeter, DME/Tacan } under
144 DME and aerials
145 Loran aerial
146 HF aerial
147 VHF aerial
148 Flaps extended (port side disconnected)
149 Wardrobe
150 Hydraulic tank, port and starboard



Shown in the sketches above is the swinging-jetty cargo loading system proposed by Vickers for use with the freighter development of the Super VC10 (and also VC10). The sequence of actions is as follows: (1) Aircraft taxied in with aid of leading marks; dock rotated to align with fuselage. (2) Nose opened; jetty moved forward on carriage to connect with fuselage sill; incoming load winched out and jetty swung to dock. (3) Jetty carrying outgoing pallet train realigned with aircraft, load transferred. (4) Jetty returned to dock, apron clear

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A total of 76 Vikings are owned by 25 airlines. Asking price for a good Viking is now about £12,000. *Flight* reference, giving full data, November 20, 1959.

Viking 3 A modification by Eagle Aircraft Services, primarily to the cooling system of the Hercules 634, enables Viking 1, 1A, 1B and 2 payload to be increased by 1,200 to 1,400lb where it is limited by WAT curves. Eagle designate modified aircraft **Viking Mks 3, 3A, 3B and 4.**

Viscount 700D The Viscount had its origins in the Brabazon Committee Type IIB requirement of March 1945 for "a 24-seat aircraft, powered with four gas turbine engines driving airscrews for European and other short-to-medium range services." The V.630 Viscount prototype, seating up to 36 passengers, made its first flight on July 16, 1948, but for BEA it was stretched into the V.700 with 1,400 s.h.p. RDa.3 Darts and seating up to 53 passengers; the prototype V.700 first flew on August 28, 1950. A month before, the V.630 prototype had been used by BEA on the world's first scheduled commercial passenger services with a turbine-powered aeroplane; the corporation introduced services with its production V.701s on April 19, 1953. A total of 285 V.700s have so far been sold; the basic V.700D differs from the V.700 in having the more powerful RDa.6 Darts, more fuel and increased take-off weight.

BEA's V.701 Viscounts have been converted to a high density version with 63 seats and airstairs. The Viscount 700's secondhand price is around £200,000-£250,000. New price in 1958 was about £400,000 ($1.1m); production ceased in 1959.

Flight references: July 15, 1955 (history and origins; development of North American versions), January 31, 1958 (Local Service Viscount).

Powerplant: Four Rolls-Royce RDa.6 Dart 510 turboprops of 1,740 e.h.p. (1,600 s.h.p.) each driving 10ft Rotol propellers.

Dimensions: Span, 93ft 8½in; length, 81ft 10in; height, 36ft 9in; wing area, 963 sq ft.

Weights: Max take-off, 64,500lb; landing, 57,500lb; zero fuel, 50,168lb; capacity payload, 11,600lb; weight less fuel and payload, 38,358lb.

Payload accommodation: Cabin volume, 2,370 cu ft; baggage and freight volume 215 cu ft; cabin length, 45ft; max width, 10ft; max height, 6ft 6in; usable floor area, 430 sq ft; dimensions of largest door, 63½ × 55in (elliptical); max seats, 63 at 34in pitch.

Fuel capacity: 2,206 Imp gal plus 110 Imp gal water-methanol.

Performance: Opt-cost cruising speed, 270kt (310 m.p.h.) at 20,000ft and 57,500lb; corres fuel consumption, 335gal/hr; balanced field length at max take-off weight, sea level, ISA, 5,310ft; sea level, ISA+15°C, 5,850ft; 5,000ft, ISA, 7,200ft; landing distance from 50ft (unfactored), 2,920ft; range A (max payload), 1,550 n.m. (1,780 st.m.); range B (max fuel), 1,740 n.m. (2,000 st.m.) with 10,400lb payload.

Design speeds: V_{NE}, 228kt (262 m.p.h.) EAS; V_{NO}, 258kt (296 m.p.h.) EAS; V_{SO}, 88.5kt (101.5 m.p.h.) EAS.

Viscount 800, 810, 840 Development of a stretched version of the Viscount had been started by BEA and Vickers before the V.701 had entered airline service, and on February 11, 1953, BEA ordered 12 V.801 Viscounts. This version, powered by four 1,690 e.h.p. RDa.5 Darts, was to have had a fuselage 13ft 3in longer than the V.701s. But the V.801 was abandoned because it was too large for traffic requirements as then foreseen, and it was replaced by the V.802.

Apart from more powerful Darts, the Viscount 810 differs from the 800 in having a structure strengthened to cater for a higher landing weight and a higher cruising speed. To date 72 V.B10s have been sold to 14 operators.

A grand total of 424 Viscounts of all versions has been sold to 54 operators—42 of whom are airlines—in 35 countries. A handful of executive Viscount 700s, some of which are operated in military markings, have been supplied to various foreign governments as VIP and personnel transports. References: *Flight*, February 22, 1957 (Viscount 802 description); February 28, 1958 (Viscount 810 description). An operator's drawing appears on page 814. The following figures apply to the Viscount 810:—

Powerplant: Four Rolls-Royce RDa.7/1 Dart 525 turboprops of 1,990 e.h.p. (1,800 s.h.p. plus 500lb thrust), driving 10ft Rotol propellers.

Dimensions: Span, 93ft 8½in; length, 85ft 8in; height, 26ft 9in; wing area, 963 sq ft.

Weights: Max take-off, 72,500lb; landing, 64,000lb; zero fuel, 57,500lb; max payload 14,500lb; weight less fuel and payload, 43,000lb.

Payload accommodation: Cabin volume, 2,800 cu ft; baggage and freight volume, 250 cu ft; cabin length, 54ft; max width, 10ft; max height, 6ft 6in; usable floor area, 520 sq ft; dimensions of largest door, 64in × 36in; max seats, 70.

Fuel capacity: 1,900 Imp gal (2,280 US gal), plus 110 Imp gal (132 US gal) water-methanol.

Performance: Opt-cost cruise speed, 309kt (355 m.p.h.) at 18,000ft and 60,000lb; corres fuel consumption, 400 Imp gal/hr; balanced field length, sea level, ISA, 6,200ft; at sea level, ISA+15°C, 6,650ft; at 5,000ft, ISA, 8,170ft; landing distance from 50ft (unfactored), 3,150ft; range A (max payload) 1,500 n.m. (1,725 st.m.); range B (max fuel) 1,530 n.m. (1,760 st.m.); corres payload, 14,300lb; range B with slipper tanks, 1,930 n.m. (2,220 st.m.).

Design speeds: V_{NE}, 285kt (328 m.p.h.) EAS; V_{NO}, 256kt (294 m.p.h.) EAS; V_{SO}, 92.5kt (106 m.p.h.) EAS.

Basic price: £535,000 ($1.5m).

V.950 Vanguard The Vanguard was the culmination of two years' detailed discussion between BEA and Vickers and Rolls-Royce, in 1954 and 1955, for a Viscount replacement. The corporation drew up a 50-page specification early in 1955 and in October of that year placed an order for 20 aircraft at a price, with spares, of approximately £1 million each. In January 1957, after "one of the most exhaustive analyses ever undertaken," TCA placed an order for 20 aircraft and parts worth £23.9 million. The airline announced its intention to buy three more on April 27, 1960.

The first Vanguard, G-AOYW, made its first flight on January 20, 1959. By the beginning of June 1960, when eight aircraft had flown nearly 1,400hr, the BEA Vanguard V.951 was ready for ARB type-certification with delivery of six to BEA scheduled for June-August. A fault in the Tyne compressor discovered by Rolls-Royce on the test bed, and the subsequent modifications, led to a revision of the programme. Following 250hr of intensive "engine-assurance" flying by V.951 G-APED during October and early November 1960, full certification is expected in the near future with first deliveries to BEA and also to TCA by the end of November 1960. BEA plans to introduce the Vanguard on its London - Paris route on an *ad hoc* basis over Christmas, with full schedules starting on March 1. The corporation intends to introduce the Vanguard on its London - Glasgow route on April 1, and to Edinburgh and Belfast—and international routes other than Paris—during the summer of 1961. TCA is hoping to introduce the Vanguard on its domestic services early in January 1961.

By the beginning of November 1960, eleven Vanguards (Vickers' own V.950 G-AOYW; six BEA V.951s; four TCA V.952s) had flown more than 1,800hr.

BEA will have six Type 951s, with Rolls-Royce Tyne 506s, and with a maximum weight of 135,000lb. The remaining 14 will be Type 953s with the same engines but with a higher maximum weight (141,000lb) and increased payload. TCA's aircraft will be V.952 with Tyne 512s of 5,545 e.h.p.—560 e.h.p. more than the Tyne 506.

Flight references: January 9, 1959 (special issue); July 25, 1958, page 129. A cutaway drawing appears on pages 822 and 823.

The following data are for the V.952 Vanguard, this version being based on that for TCA:—

Powerplant: Four Rolls-Royce Tyne RTy.11 (Mk 512) turboprops of 5,545 e.h.p. each, driving de Havilland Hydromatic trapezoidal-blade 14ft 6in propellers.

Dimensions: Span, 118ft; length, 122ft 10½in; height, 34ft 11in; wing area, 1,529 sq ft.

Weights: Max take-off, 146,500lb; landing, 130,500lb; zero fuel, 122,500lb; capacity payload, 37,000lb; weight less fuel and payload, 85,500lb.

Payload accommodation: Cabin volume, 5,690 cu ft; baggage and freight volume, 1,360 cu ft; cabin length, 90ft; max width, 10ft 9in; max height, 6ft 10½in; max usable floor area, 893 sq ft; dimensions of largest doors, 6ft × 3ft 5in (passenger door), 3ft 10in × 5ft 6in (freight); max seats, 139 at 34in pitch.

Fuel capacity: 5,100 Imp gal (6,125 US gal).

Performance: Opt-cost cruising speed at 20,000ft, 135,000lb; 358kt (412 m.p.h.); corres fuel consumption, 710 Imp gal/hr; field length, max take-off weight, sea level ISA, 5,200ft; sea level ISA+15°C, 5,850ft; elev 5,000ft, ISA, 7,200ft; landing from 50ft, 3,970ft; range A (max payload), 1,590 n.m. (1,830 st.m.); range B (max fuel), 2,720 n.m. (3,130 st.m.); corres payload, 20,500lb.

VC10 Now under construction at Weybridge and Hurn are components of the first of 35 VC10s ordered by BOAC for delivery in 1963. An intention-to-order was announced in May 1957 and the contract was signed in January 1958. All VC10s will be production aircraft and the first should fly early in 1962.

The VC10 will be comparable in speed and payload-range with the US big jets but Vickers, in addition, decided "to concentrate on the airfield performance and economy of an aircraft that could cruise at 600 m.p.h." To this end—and to reduce noise and vibration in the cabin—the Rolls-Royce Conway engines are grouped at the rear of the fuselage to give a completely clean wing. Upon this wing full-span leading-edge slats and flaps can be employed to give maximum lift at low speeds and low cruising drag.

Main *Flight* references to the VC10 are January 24, 1958, July 28, 1958, October 2, 1959, November 20, 1959, February 19, 1960 and October 7, 1960. Price of the standard aircraft, without spares, is **£2.1m.**

Powerplant: Four Rolls-Royce Conway RCo.42 by-pass turbojets of 20,250lb static thrust for take-off.

Dimensions: Span, 140ft; length, 158ft 10in; height, 39ft 1½in; wing area, 2,800 sq. ft; sweepback at ¼ chord, 32.5°.

Weights: Max take-off, 299,000lb; max landing, 197,000lb; zero fuel, 176,500lb; max design payload, 38,000lb.

Vickers Viscount 810 (Rolls-Royce Dart 525 turboprops)

Payload accommodation: Cabin volume (less flight deck) 6,700 cu ft; baggage and freight volume, 1,350 cu ft; cabin length, 91ft 4in; max internal width, 11ft 6in; max height, 7ft 6in; max seats, 150 (six-abreast) at 34in pitch.

Fuel capacity: 17,250 Imp gal (20,700 US gal).

Performance: Optimum-cost cruising speed 480kt (552 m.p.h.) at 35,000-42,000ft and 240,000lb; balanced field length, ISA, sea level, 7,400ft; at ISA+15°C, sea level, 8,650ft; at ISA at 5,000ft, 9,500ft; landing distance, 6,400ft; range A (max payload), 4,800 n.m. (5,530 st.m.); range B (max fuel), 5,600 n.m. (6,400 st.m.); corres payload, 24,500lb; V_{NE} 0.88M; V_{NO}, 0.86M; V_{SO}, 95kt (110 m.p.h.) EAS.

VC10 Freighter Two freighter versions of the VC10 have been announced—a window-less swing-nose (starboard-side hinge) model based on the standard VC10 and a similar configuration based on the Super version. Both are combined in conception with an overall terminal loading system and with the use of pre-palletized freight (see page 825). Weight-limited payload of the standard freighter is about 90,000lb. No price has been quoted.

Powerplant: Four Rolls-Royce Conway RCo.42/3 by-pass turbojets of 22,500lb static thrust for take-off.

Dimensions: As Super VC10 except length, 158ft 10in.

Weights: Max take-off, 347,000lb; max landing, 25,150lb; zero fuel, 243,250lb; capacity payload, 90,000lb; weight less fuel and payload, 137,000lb.

Payload accommodation: Main freight hold, 6,700 cu ft; under-floor freight volume, 1,300 cu ft; cabin length, 85ft 8in; max internal width, 11ft 8in; max height, 7ft 10in; max usable floor area (less flight deck), 934 sq ft.

Fuel capacity: 18,750 Imp gal (22,500 US gal).

Performance: Optimum-cost cruising speed, 486kt (559 m.p.h.) at 36,000ft and 280,000lb; corres fuel consumption, 1,930 Imp gal/hr; range A max payload), 3,950 n.m. (4,540 st.m.); range B (max fuel), 4,800 n.m. (5,530 st.m.); corres payload, 55,000lb; V_{NE}, 0.88M, V_{NO}, 0.86M; V_{SO}, 112kt (129 m.p.h.) EAS.

Super VC10 When BOAC placed its order for 35 VC10s, an option was taken on a further 20. Ten of these are now to be Super VC10s, a contract for which was signed on June 23 this year. The aircraft are to be delivered from early in 1965 primarily for BOAC's North Atlantic routes. With the exception of Aeroflot's Tu-114 the Super VC10 is the largest commercial airliner ever ordered, the fuselage—stretched by 27ft—accommodating up to 212 passengers. *Flight* references are July 1, 1960, and September 9 and a cutaway drawing appears on pages 824 and 825. More expensive than the VC10, each aircraft will cost about £2.5m.

Powerplant: Four Rolls-Royce Conway RCo.42/2 by-pass turbojets of 21,825lb static thrust for take-off.

Dimensions: As for VC10 except span, 146ft; length 186ft.

Weights: Max take-off, 347,000lb; max landing, 241,000lb; zero fuel, 219,000lb; capacity payload, 58,000lb; weight less fuel and payload, 161,000lb.

Payload accommodation: Cabin volume (less flight deck), 8,450 cu ft; baggage and freight volume, 2,000 cu ft; cabin length, 118ft; max internal width, 11ft 6in; max height, 7ft 6in; max usable floor area (less flight deck), 1,225 sq ft; dimensions of largest door, 72in × 24in; max seats, 212 at 33in pitch.

Fuel capacity: 18,750 Imp gal (22,500 US gal).

Performance: Typical economy cruising speed, 470kt (541 m.p.h.) at 38,000ft and 250,000lb. Corres fuel consumption, 1,500 Imp gal/hr; range A (max payload) 4,230 n.m. (4,840 st.m.); range B (max fuel) 5,180 n.m. (5,960 st.m.); corres payload, 35,000lb; V_{NE}, 0.88M; V_{NO}, 0.68M; V_{SO}, 104kt (121 m.p.h.) EAS.

Super VC10 Freighter Fuselage length of this very large all-freighter is slightly greater than that of the passenger-carrying Super VC10, but weight-limited payload—106,000lb—is very much greater. Direct ATA formula costs are calculated to be between 5.6 and 6.2 cents per ton n.m. over sectors of 1,200 to 2,400 n.m. A previous *Flight* reference appeared on September 9, 1960, and an operator's drawing appears on pages 811 and 812 of this issue. No price has been quoted.

Powerplant: Four Rolls-Royce Conway RCo.42/3 by-pass turbojets of 22,500lb static thrust for take-off.

Dimensions: As Super VC10 except length, 186ft 11in.

Weights: Max take-off, 347,000lb; max landing, 269,250lb; zero fuel, 243,250lb; capacity payload, 98,250lb; weight less fuel and payload, 145,000lb.

Payload accommodation: Main freight hold, 8,450 cu ft; under-floor freight volume, 2,520 cu ft; cabin length, 113ft 8in; max internal width, 11ft 8in; max height, 7ft 10in; max usable floor area (less flight deck), 1,225 sq ft.

Fuel capacity: 18,750 Imp gal (22,500 US gal).

Performance: Optimum-cost cruising speed, 486kt (559 m.p.h.) at 36,000ft and 280,000lb; corres fuel consumption, 1,930 Imp gal/hr; range A (max payload), 3,950 n.m. (4,540 st.m.); range B (max fuel), 4,800 n.m. (5,530 st.m.); corres payload, 55,000lb; V_{NE}, 0.88M, V_{NO}, 0.86M; V_{SO}, 112kt (129 m.p.h.) EAS.

Developed Super VC10 Announced in September was another version of the Super VC10 in which the fuselage length is increased by a further 10ft to 196ft 6in, maximum passenger capacity to 222, and maximum gross weight to 360,000lb. All versions of the Super VC10 have common wings and rear fuselage, the increased length being ahead of the wing. The developed Super VC10 is associated with four Rolls-Royce Conways of 24,000lb thrust or with the Allison AR.972-2 version. *Flight* reference, September 9, 1960.

Powerplant: Four Rolls-Royce Conway RCo.42/7 by-pass turbojets of 24,000lb static thrust for take-off.

Dimensions: As Super VC10 except length, 196ft 6in.

Weights: Max take-off, 360,000lb; max landing, 245,000lb; zero fuel, 222,000lb.

Payload accommodation: Baggage and freight volume, 2,300 cu ft; cabin length, 129ft 9in; max internal width, 11ft 6in; max height, 7ft 6in; max seats, 222.

Fuel capacity: 20,000 Imp gal (24,020 US gal).

VC11 No official details of this "junior VC10" have been published but sufficient is known about it to make informed speculation possible. It is the medium-range member of the Vickers jet transport family, falling between the standard VC10 (to which it bears a strong family resemblance) and the BAC-107, with which it is being promoted "au pair" to some operators. Powered by four Rolls-Royce RB.163s, and with a maximum weight of the order of 170,000lb, the VC11 will have a full payload (138 seats plus freight) range performance, with fuel reserves, of about 1,800 st miles. Tankage will be over 7,000 Imp gal and cruising speed a genuine 600+ m.p.h. Other "unofficial" figures (dated April 1960): landing weight, 138,500lb; zero fuel weight, 123,500lb; weight less fuel and payload, 93,585lb; length, 136ft; span, 103ft.

WESTLAND *Westland Aircraft Ltd, Yeovil, Somerset.*

Rotodyne See Helicopters of the World special issue of *Flight*, May 27, 1960, page 712.

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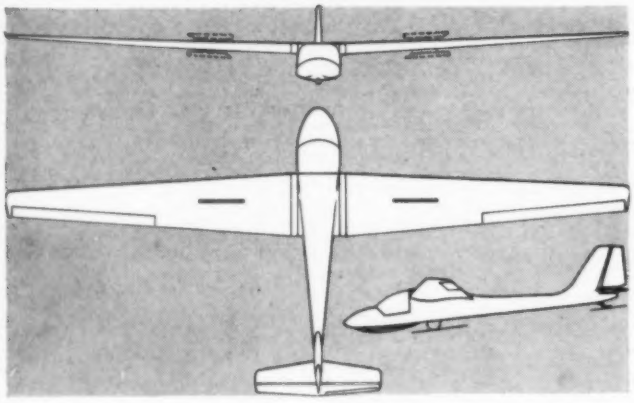


First illustration of the Slingsby Type 49 two-seat training glider, now under development at Kirbymoorside (see first news item)

Sport and Business

A SHALLOW FUSELAGE and a laminar-flow wing are among the main design features of the Slingsby Type 49, a new two-seater glider now being developed by Slingsby Sailplanes Ltd. Illustrated in the g.a. drawing above, the aircraft is intended to be a successor to the well-known T-21b *ab initio* trainer, which has been in continuous production at Kirbymoorside since 1947. The intention with the Type 49 is that it should be used not only for basic instruction, but also for training in cross-country and cloud flying. Performance details have not yet been released, but the new glider should have a best gliding angle of about 1 : 26 and general performance comparable to that of the Skylark 2.

Because of its laminar-flow wing, the Type 49 should make the transition process from trainer to high-performance single-seater an easier step. The enclosed cockpit will accommodate two pilots side-by-side—pilots who, according to the company, may be from 5ft 4in to 6ft 4in in height—and the seats, seat-backs and control columns are adjustable.

"The aerodynamic and structural design," the company states, "will incorporate many new developments that have appeared in recent years but we have intentionally avoided features that will make the aircraft difficult to maintain by the operators. Inspection facilities and access to the structure have been major considerations in the design. The result of this work will be an aircraft which, while not low in initial cost, will have a high revenue-earning potential and low operating costs and so be capable of paying for itself over a short period of time."

The selling price envisaged by the company is approximately £1,500. Several provisional orders have already been placed, and production deliveries are expected to begin next October. First flight of the prototype should be made next April. At present the main design has been finalized with the aid of mock-ups of the front fuselage and the tail; detail design is now beginning; and construction of detail parts will begin next month. The type is designed to obtain full clearance for aerobatics, cloud-flying and all forms of towing.

DISCUSSIONS on the implications of the fatal accident to an instructor and pupil of London Gliding Club on September 30 are taking place between the Ministry of Aviation and the British Gliding Association. It was stated at the inquest that the instructor, Mr John Westhorpe, had suffered for some years from epilepsy and from acute tuberculosis. In the House of Commons on November 7 Mr Barnett Janner asked the Minister of Aviation "whether he will inform such clubs that all instructors must pass a rigid health test before taking up such employment." The Parliamentary Secretary to the Ministry, Mr Geoffrey Rippon, replied that discussions with the BGA were taking place. Mr Janner continued: "In view of the very serious effect of the illness that this unhappy man suffered, will the Parliamentary Secretary see to it that no person suffering from epilepsy shall be allowed to fly gliders. . . ?" Mr Rippon replied: "At the present time no powers exist to direct gliding clubs or individuals to impose these health tests. Naturally, this is one of the matters which we shall be discussing carefully with the British Gliding Association."

AN AERO COMMANDER 520 has been purchased by Contracting & Trading Co for the personal transport of the company chairman, Mr Emile Bustani, in the Middle East, where the firm is engaged in large-scale civil contracting work. The aircraft was handed over by Mr K. C. Keegan, sales manager of Keegan Aviation Ltd, at Panshangar on November 8.

RETROSPECT

From "Flight" of November 19, 1910

Flying Home from Aeroplane School: Having completed his course of instruction at the Bleriot School at Etampes, Eugene Duflot decided to fly back to his home at Vervins. Although there was a thick mist over the ground, he left Etampes on Saturday morning, but he had not proceeded far when he found he had lost his way. He therefore landed at the first convenient spot, which proved to be Aulnay-les-Bondy. Almost immediately afterwards he started again in the direction of Soissons, but when within 2 kiloms. of his destination, he was obliged to land in order to replenish his fuel tank, &c. This done he started off once more and soon reached his destination, the total distance covered during the journey being 200 kiloms.

NOW REPORTED to be in Sweden undergoing certification testing is the Andreasson BA-7 light side-by-side two-seat sports aircraft, which has achieved a cruising speed of 135 m.p.h. with a 75 h.p. engine. Stalling speed is about 55 m.p.h. and gross weight under 2,000lb. Structure is all-metal, the fuselage being based on four external longerons with thick skin panels and very few frames. The wing, of NACA 23000 series section, has two extruded spars and thick skin with few ribs, root and strut fittings being designed to allow folding despite the small span of little over 20ft.

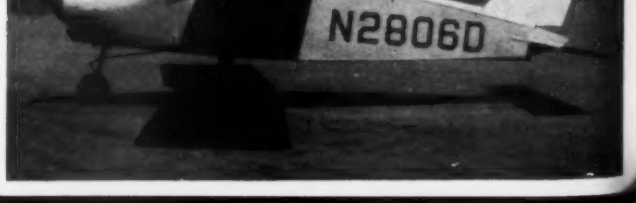
Flaps and ailerons are made of spars and end ribs with foam-filled metal-envelope structure. The tail surfaces are also foam-filled. Aileron cables pass behind the front spar to cranks, rods and mass-balances all located within the plastics tip-fairings.

The original all-moving rudder has been replaced by a conventional fin and horn-balanced rudder, but the tailplane remains an all-moving slab with trimmable anti-balance tab and projecting mass balance. The nosewheel is steerable and the mainwheels have spring-rod legs and non-differential brakes. A single short control column between the pilots affords dual control.

Controls of the early BA-7 prototype were reported to be very sensitive, but they are being improved. The high cruising speed should make the BA-7 a useful and economical travelling aircraft. Production versions are to be powered by Continental 90/100 h.p. engines, which might well raise cruising speed to 150 m.p.h. Bjorn Andreasson, the designer and builder of the prototype, is an engineer with Convair at San Diego.

Left, at the Kronfeld Club Art Exhibition reported in last week's issue. Mrs Rika Harwood, Miss Anthea Russell (secretary of the British Gliding Association) and Mrs Margaret Kahn are seen with a few of the exhibited pictures. Top left is "Cross-country," by Mrs Kahn, while on the right is part of one of four Gordon Horner sketches which first appeared in "Flight"

Below, the Andreasson BA-7 two-seater, designed by Convair engineer Bjorn Andreasson and now undergoing testing in Sweden, has a cruising speed of 135 m.p.h. on an engine of only 75 h.p. (see final news item above)



Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

Traffic-control Communications

I REALIZE that your report of a Viscount accident (*Flight*, September 30) was greatly abbreviated, but to say that the "prime cause" was that ATC did not advise the pilot of deteriorating visibility seems to me very odd. What chance did the controllers have of passing up-to-date weather information to any pilot on approach? How can a man be criticized for not doing a job if he is not given the proper tools to do the job?

First let us examine procedures. The runway controller passes the RVR by telephone to the airport controller, who in turn passes it by telephone to the approach controller, who then has to write the information on a form. By inference (from the later mention of a direct 'phone line) these messages had to go through some sort of a switchboard. I would like to know how long it would take to pass information through this chain during a period of heavy traffic when any of the controllers could be too busy to answer the 'phones immediately.

Obviously the procedure was all wrong, as two months later it was changed by installing a direct 'phone and installing an "indicator." Was this the follow-up of a suggestion made in November 1958? I did not intend to be too critical of London Airport procedures. No doubt approach controllers all over the world are sitting in their dark little rooms worrying about sudden changes in weather. Surely in this age of electronics ATC could be given some method of visually presenting pertinent information quickly.

I remember reading a paper presented to the Guild of Air Traffic Controllers in 1956. It covered many important points, but one sentence comes to mind, "There is an increasing tendency these days for a telephone complex to creep into aerodromes and centres." I wonder if anyone will ever listen to and accept the ideas or suggestions of the low man on the ATC totem-pole.

Calgary, Alberta PERPLEXED

[The implication in the first paragraph of this letter is that *Flight's* abbreviation of the Ministry of Aviation report in some way distorted the opinion of the Deputy Chief Inspector of Accidents as to the prime cause of the accident to BEA Viscount G-AOHU at London Airport on January 7, 1960. This is not the case. Under "Opinion," the relevant extract from the report reads: "Because of the conflicting evidence given by the Air Traffic Control Officers the source of the failure to pass the 250yd deterioration to the aircraft cannot be ascertained. This failure was the prime cause of the accident. The deterioration to 100yd was not passed to the aircraft because No 1 Director withheld it on his own initiative."—Ed.]

The Munich Accident

RECENT issues of your journal have referred to my criticism of BALPA actions, subsequent to the official German inquiry into the Munich accident. This criticism was originally published in the official journal of BALPA, and I have no intention of being drawn into a detailed argument outside the Association.

However, the BALPA statement, issued after the publication of the report of the Fay Commission, claims that criticism of the Association cannot be upheld, because the Fay Commission itself paid tribute to the objectivity of the Association. Since this is obviously a reference to my criticism I am entitled to make certain points clear.

Firstly, I have never criticized the attitude of the Association in front of the Fay Commission, but I would point out that the Fay Commission was not intended to conduct an investigation into the causes of the accident. Capt Thain, together with BALPA, was before the Fay Commission to claim that an adequate inspection of the wings had been made, and that there was no ice on the wings at the time of the final attempt to take off.

I have never contested the view that slush on the runway could have been a cause of this accident. On the contrary, I was one of the first to protest when, soon after the accident, statements were being made attributing the cause to wing icing. At the same time, I drew attention to an experience of my own, when I was forced to abandon a take-off in an Elizabethan, due to a large amount of slush. I subsequently gave evidence to the German commission about this incident.

I have never said that the German report could not be faulted. I have, in fact, drawn attention to some of the inconsistencies myself.

What I have protested about is the policy of the Association with regard to the problem of wing icing. I have been convinced, from the time the German inquiry concluded, that it was impossible to deny that no adequate inspection of the wings was made before the last take-off attempt. In the weather conditions prevailing, acceptance of this fact meant that the probability of ice on the wings had to follow. These are matters on which the pilots' association should be the acknowledged experts. Indeed, many members of BALPA are appointed agents of the Minister, and are responsible to him for ensuring that the regulations are complied with. It was quite incompatible with the BALPA claim to professional status to maintain that no error had been made, and quite futile to make such a claim. This has been borne out by the report of the Fay Commission.

On the question of the causes of the accident, I had formed certain opinions as a result of my attendance at the German inquiry. I have never claimed that my opinions are any more valid than those of persons who have made an equally serious study of the evidence. However, because my opinions did not coincide with those of persons who wished to dismiss wing icing entirely from BALPA investigations, I became involved in a dispute which resulted in my elimination from the BALPA study of the accident. I would have been prepared to accept this position had BALPA been prepared to accede to my request that it should be made known that I was no longer concerned in BALPA actions. Here it should be remembered that I had allowed my name to be used as that of a BALPA representative before the German commission.

It would have been quite possible to challenge the conclusive nature of the German finding, without committing the Association to the opinion that the Elizabethan wing could be inspected from the cockpit, that in conditions of falling snow and zero temperature, wing icing was not a possibility; and that, if wing icing were present, it was of academic interest only.

It is true that a lot of useful knowledge concerning the effect of slush has emerged from the study of this accident. However, this could have been achieved by other tactics.

As far as Capt Thain's position is concerned, BALPA as a trade union is now in the position of trying to find mitigating circumstances for an error which, until the report of the Fay Commission was published, it had denied. I believe that, in the circumstances surrounding this accident, it is possible to excuse the error, and at any time since the German inquiry concluded I would have been prepared to associate myself with the preparation of a case to defend Capt Thain. This was never possible, because the attitude of BALPA was that he had done nothing wrong.

Finally, I would say this. My criticism of BALPA was that it had not conducted an objective investigation into the accident, and that an attempt had been made to discredit the German report by the publication of a BALPA report, based on selected evidence, which was published in *The Log*. It was not a criticism of the German report but what purported to be an objective evaluation of *all* the evidence, and it was knowingly presented to persons, the majority of whom could have had no detailed knowledge of the evidence. The Fay Commission has now made a detailed evaluation of the evidence upon which the BALPA report was based, together with certain other evidence and information. This is my idea of an objective evaluation, and there was no reason why similar conclusions should not have emerged from a BALPA investigation.

London Airport, Middx STANLEY J. L. KEY

"The Flying Years"

I AM afraid Mr Doorpost does miss the point about historical films. For some strange reason the beginnings of flight have an overwhelming fascination for thousands of people of all ages and the accuracy of the chronicle affects these people like myxamot—whatever it is. I do agree that in an ephemeral thing like a TV programme it does not matter so much. Those who know their stuff know it to be inaccurate—and those who don't, don't care. If anybody's curiosity is aroused by the series they can always read it up and get the true facts (providing they read one of the accurate histories and not one that has had to be amended but never reached a second edition for those amendments to see print). What is wrong is that an air of authority should be given by using a reputable commentator on badly checked material.

Another deplorable aspect is that several bodies were listed as having helped in the programme's preparation. This gives an impression that their advice may have been sought. In at least one case, the only "help" was the lending of some photographs to the BBC with no indication of what programme they were intended for.

London W1 FRANK DORMOUSE

YOUR contributor Mr Roger Bacon is terribly funny and, since I have criticized the programme called *The Flying Years*, I suppose that the nitpicker cap will be expected to fit; I do not propose to wear it, however. I certainly decline to discuss the apparent slur on Hamel's name, which Mr Geoffrey Dorman, myself and probably many others, somewhat resent, under the heading "nitpickers."

There is, however, one point which Mr Bacon seems to have overlooked—due, no doubt, to the fact that his page is of the more flippant variety in which accuracy is not of paramount importance.

In an ordinary film, it does not matter if an aircraft goes up

CORRESPONDENCE . . .

as a monoplane and comes down as a biplane or *vice versa*, for the public won't notice the difference, or care.

In a documentary it is of little actual consequence if a Sopwith "This" is described as a Sopwith "That" *per se*—who cares? Nevertheless, and this is the point, it does mean that it makes one wonder if other films are full of clangers. I may see documentaries on, for example, the history of surgery, in which I am interested but of which I know very little. I come away thinking I have learned something because the film is vouched for by responsible authorities. I then see a documentary on the history of flying, of which I modestly admit a good knowledge, and I find all sorts of clangers in a film boasting similar research. At once seeds of suspicion are sown and I wonder if the film on surgery or what have you is—bunkum.

In any case, is it so very bad to expect accuracy in a book, film or talk which purports to be a history?

Potters Bar, Middx — A. H. CURTIS

I WAS deeply hert by Mr G. Doorposts attack on me and my pal Mr G. Dormouse. After all, him and me are quite disgusted with all the tommy rot spoke about soupersonick planes and all that and to think too about all such rediccerlus fuss and all just so a Frenchy sex-kitten and some fat breef-case can be encapsulated like, and sent willy-nellie to Noo Yorke. And all this rude talk too by the yunguns today about "bristling with inconsequential fact" (see *Flite*, Nov. 4, p. 703) and much worse langwidge all this speed leeds to. So us two we just try to put the old brake on a bit you know and turn the clock back to sanity, to 1928 when Col Lawrences airship *Lady Chatterly* took off and crashed —Dormouse and me both saw that terrible sad day—and then back to 1908 when old Wilber came over and showed us all how. So please sir please shut Mr Doorpost up and tell him not to interfeer thank you.

Heath Roe, Middelsex — C. H. JIBBS-SNIFF

WITH reference to the letter from G. Doorpost, I suppose there *are* people to whom accuracy means nothing—but it's dreadful to think there's one at London Airport! I hope I never fly in an aircraft with which he is concerned. Could he have been the pilot who landed at the wrong airport in a 707—Northolt instead of LAP? He sounds just the type who would!

London W14 — GEOFFREY DORMAN

AFTER reading the letter by Mr Doorpost in your issue of November 4, I wish to state that past events in aviation are just as important as happenings of the present time, whether it's aviation or any other walk of life. If there had not been any past events Mr Doorpost would not be able to read the present happenings of modern times.

Now I wish to ask a question a bit out of date. What happened to the Martinsyde monoplane that was under construction in 1914, for Mr Gustav Hamel's Atlantic attempt for the *Daily Mail* £10,000 prize? It was still under construction at the time of his fatal cross-Channel flight. I should be interested to know if the machine was completed and flown.

Southampton — L. HEATHER

[The following extract from *Flight* of March 5, 1915, provides the answer to Mr Heather's question: "In 1911-12 were produced what was known as the Martinsyde single seater and the Military Trials machines, and later on came the giant monoplane designed for the Transatlantic flight. As is well known to our readers, work on that machine had to be stopped for reasons outside the control of the designers, but parts of it are still about in the works." It was never completed.—Ed.]

Clean Tarmac, Move Steps

IN "Straight and Level," page 677, October 28, Roger Bacon comments on the state of the tarmac at Gatwick in the photograph on page 684 of the arrival of the King and Queen of Nepal on their State visit to the UK.

May I add a somewhat belated request that whoever positioned the passenger steps should take an elementary course in navigation or alternatively get a new pair of spectacles.

Surely a door the size of a Viscount door is not so small that it can be missed.

RAF Wildenrath, Germany — SAC M. J. ODY

FORTHCOMING EVENTS

Nov. 19. Kronfeld Club: Film Show.
Nov. 20. Association of British Aero Clubs and Centres: Annual Dinner.
Nov. 21. RAeS Historical Group: "My First Ten Years in Aviation," by Sir Thomas Sopwith.
Nov. 22. BritIRE (Southern Section): "Radio Aids for Automatic Landing Developed by the Blind Landing Experimental Unit," by J. S. Shayler.
Nov. 22. BritIRE (South Western Section): "Transistors in Control Circuits," by E. Wolfendale.
Nov. 22. RAeS: "Basic Aerodynamic Considerations of V/STOL Aircraft," by P. L. Sutcliffe.
Nov. 23. BritIRE (South Wales Section): "Radio Navigational Aids in Aircraft." (Lecturer to be announced.)
Nov. 23. Kronfeld Club: "The Sea and Sailing," by Mike Gee and Frank Irving.
Nov. 23. RAeS Graduates' and Students' Section: "The British Space Programme," by M. O. Robins.

RAeS Branch Fixtures (to Nov. 25): Nov. 23, *Glasgow* (Graduates' and Students' Section), Lecture by T. H. Cain; *Hatfield*, "The Physiological Limits of Man-powered Flight," by Dr D. R. Wilkie; *Weybridge* (joint meeting with Southern Branch of the Institution of Mechanical Engineers), "The Art of Developing Aero Engines," by A. C. Lovesey.

THE INDUSTRY IN BRIEF

Castrol 98 is now being used for the lubrication of Avons in Olympic Airways' Comets and Darts in Lufthansa Viscounts.

High Duty Alloys Ltd have announced changes in the telephone numbers of their forging division to Redditch 4211 (day) and 4162 (night).

Negretti & Zambra Ltd have opened a Newcastle branch at 38 Dean Street, Newcastle on Tyne (telephone 20420). It incorporates a showroom and service and supply depots.

Mr A. H. Fuhrig was recently appointed manager, technical division, of the Goodyear Tyre & Rubber Co (Great Britain) Ltd, in succession to Mr H. L. Matheson, who has returned to the parent company in Akron, Ohio, for re-assignment. Mr Fuhrig has been at the company's Wolverhampton plant for two years in the capacity of assistant manager of the technical division

Mr E. Chatterton, BSC(ENG), MIMECHE, FRAES, who has been acting as engineering consultant to the Coventry Victor Motor Co Ltd, has now been appointed technical director.

An Air Ministry contract has been awarded to Petbow Ltd for the supply and installation of eight 200kVA stand-by mains-failure generating sets for the "Ace High" project. Four stations are being equipped with two of the sets each plus associated equipment. The first station is due for completion early next year.

The new address of Birfield Ltd is 20 Hill Street, London W1. The telephone number is still Grosvenor 7090.

Mr H. J. Billing, AMIMECHE, has been appointed sales director of Metalastik Ltd. He joined the company in 1951, becoming sales manager in 1956.

Mr F. Bastow, managing director of Dowty Seals Ltd, and Mr S. Hinchliff, the company's production director, recently visited Malta to conclude initial arrangements for the factory which Dowty Seals are setting up in the island.

A new publication designed for the welder of dissimilar metals, *Inco-Weld "A" Welding Electrode and Filler Wire*, is obtainable from the publicity department of Henry Wiggin & Co Ltd, Thames House, Millbank, London SW1.

A leaflet from Vactric (Control Equipment) Ltd of Vactric House, Sloane Street, London SW1, gives abridged technical data on their range of precision servo components.

An illustrated leaflet describing a new type of PVC-insulated multicore radio cable for use in civil aircraft, M106, has been published by Rist's Wires & Cables Ltd, Lower Milehouse Lane, Newcastle, Staffs. The M106 type of cable is used in the Vickers Vanguard.

Pritchett & Gold and E.P.S. Co Ltd have moved their Victoria Street, London, office (containing the automotive, aircraft and stationary batteries sales divisions) to the company headquarters at Dagenite Works, Dagenham Dock, Essex, where a new two-storey office block has been built.

A booklet has been published describing the consultancy services of Power Jets (Research & Development) Ltd. The company's consultancy department is now located at The Croft, 112 Church Lane East, Aldershot, Hants (tel Aldershot 20451). The registered office is still at 25 Green Street, London W1 (Mayfair 7801).